“The Infantry Cannot Do With A Gun Less” Appendices: Archival Documents

The documents below are, in each case, edited transcriptions of the originals. Spelling, punctuation, and word usage have not been modernized. Pagination has not been maintained, and footnotes from the originals have been placed at the end of paragraphs to which they referred

1: Record of work carried out by the Artillery Branch of the Headquarter Staff, South African War

Communicated by D.D.G.O
Source: *Proceedings of the Royal Artillery Institute* 30:7-9

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Introduction

The following notes were recorded at Pretoria in June, 1902, so as to indicate briefly the general scope of the administrative work dealt with by the Artillery branch of the Head Quarter Staff in South Africa during the war. It must be remembered that in addition to the normal proportion of horse and field artillery allotted to an army of the same size, the artillery* in South Africa comprised a siege train and a large number of other guns of various natures, ranging from the 9.2" mounted on a railway truck to the pompom, and including many which were not of service pattern. [* See list of units in Appendix I., and of guns in Appendix II. below.]

As regards personnel, the general administration was complicated by the presence of many units provided by colonial forces or improvis-ed from the Royal Artillery to meet the special requirements of the campaign. [1] Further, the demobilization of units no longer required had to be undertaken during the campaign; and this involved arrang-ing for the winding up of their pay and equipment accounts, the distribution of the personnel and the custody of their records while hostilities were still in progress.

In addition to the above purely artillery matters, certain other subjects were specially allotted to the artillery staff by the Commander-in-Chief. For the above reasons, the work done was necessarily more complex than if the administration had been confined to that of the Artillery of an army organized on ordinary lines.

For convenience of reference, these notes have been divided under the following headings :—

I. Distribution.
II. Personnel.
III. Materiel.
IV. Pompoms.
V. Machine guns.
VI. Ammunition.
VII. Remounts.
VIII. Transport.
IX. Armoured trains.

X. Boer artillery.
XI. Dynamite factory.
XII. Artillery Mounted Rifles.

Distribution.

The allotment of guns—Imperial and Colonial, heavy, field, and pompoms—to the various columns in the field, to the lines of com-munication, and to garrisons.

Provision of guns or pompoms as required for the new columns constantly being formed or re-formed.

Responsibility that guns were in no cases placed in posts with in-sufficient garrisons, or taken out with columns of inadequate strength.

Personnel.

Posting and appointment of officers, including Militia and Colonial.

Questions dealing with the non-commissioned officers and men of Royal, Militia, and Colonial Artillery (except Cape Colonial), including their posting and transfer.

Upkeep of personnel of units.

Distribution of drafts to units, including the allotment and control of the 600 Army Service Corps drivers sent out for duty with artillery.

Supply of artificers, including the distribution and administration of all specially enlisted artificers sent to South Africa, whether employed with artillery or other branches of the service.

Regulation of promotion to the rank of staff serjeant from serjeant for all Royal Artillery units in South Africa, and to the rank of farrier of all

Measures to ensure the return to their units of all men who became separated from them through sickness or other causes.

Supervision of the arrangements for the despatch of time-expired men from the base to England, and also for the forwarding of the documents of all men sent home—including invalids.

Care and custody of the base kits of units and drafts; this required constant attention owing to the frequent changes in personnel.

The preparation and despatch of batteries and companies to India and the Colonies while hostilities were still in progress.

The difficulties of dealing with all the above were much enhanced by the splitting up of brigade divisions and batteries with widely separated columns, and the changes in the designations of units as the war went on. [2]

Materiel.

Arrangements, in co-operation with the Ordnance Department, for the provision of spare guns, carriages, fittings, and technical stores generally, and for their issue to units either direct from the ordnance depots or through ammunition columns; with the precautions for their safety from capture or miscarriage in transit. This was much complicated by the large number of different natures of guns, and by the fact that many were not of service pattern. Also for the despatch home of all guns and equipment no longer required.

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Arrangements for the periodical inspection of guns by Ordnance Inspecting Officers, and for their exchange so as to keep those show-ing signs of wear in posts where they would probably not be required for heavy firing, until they could be replaced altogether and sent home.

The supply of a proportion of general stores for ammunition columns and parks to re-issue to batteries, and the establishment of repairing workshops at advanced bases when the advanced ordnance depots were not sent on with the troops.

The investigation of all damages sustained by guns or equipment.

Pompoms.

Organization of the pompoms in sections; fixing the establishment of the latter, and supplying them with personnel, horses, and mules. Alterations in pattern of carriages, limbers, &c, and demands on England for equipment required.

Machine guns.

The distribution and allotment of all machine guns, and the control of demands from home. This was complicated by the fact that there were three sorts of machine guns in use (excluding captured ones), and many more different sorts of carriages.

Ammunition.

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General responsibility to the Commander-in-Chief for all ammuni-tion in South Africa, including small-arm.

Preliminary arrangements at the base, in co-operation with the Ordnance Department, for the distribution of ammunition as regards the amounts to be held in ordnance charge, and carried in the field; and for demands on home as required. Subsequent arrangements for the fixing of the positions of ammunition depots, and of the amounts to be held in each; the establishment of new depots ready for impending movements; the evacuation or reduction of those likely to be threatened, or no longer of importance; the prevention of unnecessary accumulations or movements, and precautions for safety in transit where movements were necessary.

Arrangements for the supply of the ammunition carried in the field, including the necessary changes in the proportion of gun and small-arm ammunition to be carried in accordance with the changes in the military situation; and the settlements of the amounts to be held in charge of units in garrisons and on the lines of communication.

The complete reorganization of the ammunition park as an im-mobile unit providing ammunition depots at rail-head and other im-portant points, in advance of the Ordnance Depots.

The reorganization of the ammunition, columns according to the progress of the campaign, and finally the abolition of the Divisional, and Corps Troop columns, and the formation of "local" ammunition columns to provide for mobile forces.

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Arrangements with general officers commanding districts for the supervision of all issues—especially to irregular corps, stock riders, national scouts, and so forth—and special arrangements for supplies required by the Intelligence

Arrangements with the Ordnance Department for the periodical inspection of all ammunition in the hands of the troops, and in am-munition columns, and for the replacement of all found unserviceable. Measures to ensure care in the treatment of ammunition in the hands of the troops.

Investigation of all accidental explosions of ammunition. The whole of the above were rendered much more difficult by the multiplicity of different natures of ammunition to be dealt with: namely, seventeen sorts of artillery ammunition, and four of small-arm, or in all twenty-one different natures of ammunition.

Remounts.

Arrangements with the Assistant Inspector of Remounts for meet-ing the requirements of the artillery generally. Making out estimates of probable expenditure.

Fixing the establishments of units according to circumstances, and controlling the issues of all riding and draught animals—horses, mules, and oxen—supplied to the artillery.

Supplementing the supply from the Remount Department by utilising horses from brigade divisions on the lines of communication, and by the replacement of horses in ammunition columns, and (tem-porarily) in batteries with mules, with the necessary arrangements for providing mule harness and native drivers.

Arrangements for the supply and movement of remounts from the advanced remount depots to the troops in the field, and their distribution to units as required.

The formation of regimental remount depots, in which horses ob-tained from the Remount Department were conditioned and trained before issue to units; and where horses which required short rest and treatment were also received from units. At the end of the war there were 7616 horses in units, and 2359 in the depots, and the number which passed through these regimental depots between 1st January, 1901, and 31st May, 1902, was over 25,000.

Transport.

Reorganization of the whole of the artillery transport—both battery and ammunition column—at the commencement of the campaign, so that additional supplies might be carried. All arrangements connected with the administration and supply of the transport required by artill-ery units.

Armoured trains.

Distribution of guns and detachments for armoured trains, and general superintendence of the mounting of the guns. Arrangements with the Ordnance Department for the provision of the special am-munition and spare parts required for the guns on armoured trains at suitable depots.

Boer artillery.

Careful register of the enemy's guns, with all captured by, or from, them, so as to be able to furnish the Commander-in-Chief with an estimate of the

Identification of captured guns and ammunition, and their disposal, with accurate record of the particulars in each case.

Arrangements for placing captured guns in the field, including the provision of ammunition, sights, range-tables, &c.

All correspondence on the subject of guns allotted as trophies, and arrangements with the Ordnance Department for their delivery as required.

Dynamite factory.

Military administration of the Dynamite Factory, Modderfontein, near Johannesburg; including the decision as to the amount of dyna-mite to be manufactured, and the mines to be supplied; and also the collection of all money

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Control of all explosives in the Transvaal and Orange River Colony and all questions connected with their importation. Precautions for safety in store and transit.

Artillery Mounted Rifles.

All arrangements connected with the formation of the Artillery Mounted Rifles, and their maintenance in the field.

Fixing the organization of the various corps; deciding on their equipment; and supplying the necessary staffs, signallers, &c.

Provision of horses on formation, and arranging for the supply of trained remounts through the regimental remount depots.

Appendix I. List of Units.

Royal Horse Artillery (10 batteries).
Royal Field Artillery (45 batteries—including 6 howitzer batteries).
Royal Garrison Artillery (2 mountain batteries, and 15 companies).
Royal Garrison Artillery Militia (4 companies).
Pompom sections.
Royal Australian Field Artillery.
Royal Canadian Field Artillery.
Cape Garrison Artillery.
Prince Alfred's Own Cape Artillery.
Artillery troop, Cape Mounted Rifles.
Natal Field Artillery.
Diamond Field's Artillery.

Rhodesian Field Force Artillery.
City Imperial Volunteers battery.
Elswick Battery.
Armoured trains.
Ammunition columns.
Ammunition park.
Artillery depots.

Appendix II. Various Natures of Guns Used During the South African War.

9.45" B.L. howitzer. 50
9.2" B.L. gun.
6.3" R.M.L. howitzer.
6-inch Q.F. gun.
6 “ B.L. howitzer.
5 ,, B.L. howitzer.
5 “ B.L. gun.
4.7" Q.F. gun (several marks with different breech fittings).
15-pr. B.L. gun (service pattern).
15-pr. B.L. gun (E.O.C. pattern single motion breech action).
15-pr. B.L. gun (E.O.C. pattern steep coned breech action).
12-pr. Q.F. gun of 12 cwt.
12-pr. Q.F. gun of 12 cwt. (on field carriages—special "Elswick Battery.")
12-pr. Q.F. gun of 8 cwt.
12-pr. B.L. gun of 6 cwt. (Horse Artillery).
75 mm. Q.F. gun (Krupp).*
75 mm. Q.F. gun (Maxim-Nordenfelt).*
75 mm. B.L. gun (Krupp).*
9-pr. R.M.L. gun.
7-pr. R.M.L. gun.
2.5" R.M.L. gun.
6-pr. Q.F. gun.
3-pr. Q.F. gun.
37 mm. pom-pom.
37mm. Q.F. gun (Krupp).
1" Nordenfelt.
.450" Maxim.
.303" Maxim.
.303" Colt.
* Captured from the enemy and taken into use.

Notes:

Note 1: Thus the personnel of the artillery of the Rhodesian Field Force consisted of a mixture of Regulars, Yeomanry, and Colonials; while the equipment comprised three different sorts of 15-prs., with non-interchangeable breech fittings, sights, carriages, &c. Back.

Note 2: The maximum strength of the Artillery in the field was reached about October, 1900, when the personnel numbered about 15,000 of all ranks. Over 1,000 officers of the Regiment took part in the campaign

2: "Practice Camps, 1912, and the Lessons to be Learnt from Them"

Source: *Journal of the Royal Artillery* 39:11.

by Lieut.-Col. Hon. F. R. Bingham, R.A.
(A Lecture delivered at the Royal Artillery Institution, on Thursday, 5th December, 1912).
Brig.-Genl. N. D. Findlay, C.B., R.A., in the Chair

1 THE CHAIRMAN: Sir William Franklyn, ladies and gentlemen. I do not think Colonel Bingham requires any introduction here; I will ask him at once to deliver his lecture.

THE LECTURER: General Findlay, ladies and gentlemen: when a politician goes to a political meeting he knows he is going to speak to people who will agree with him and that the others who don't like his views won't come to the meeting; but with a Gunner speaking to Gunners, especially when innovations are in question, he will probably find that most of his hearers will disagree with him on some points and some on all. Still it is only by discussion that we dig out difficulties and get ideas for improvements.

The Committee asked me to come and talk about this year's practice camps and this year's changes, and also to say what lessons we have learnt, but one is rather shy about coming after reading the letter of the correspondent in the Morning Post who says that the advice of the junior Colonel at Shoeburyness, and his still more junior assistants is only tolerated on minor subjects of drill and fire discipline.

The innovations of the year were new "Field Artillery Training," new "Instructions for Practice," "Collective Ranging," and "Tactical Practice," changes in targets, abolition of classification, and the introduction of No. 7 dial sights.

New Field Artillery Training:

5 This year saw the advent of the new *Field Artillery Training.* The old one was one mass of amendments, was not well arranged and was not up-to-date. I think the new one meets most of these objections and every line of it spells latitude, while giving guidance as to how to carry out the handling of Artillery units. The chapter on Employment of Artillery in War is extraordinarily good. One sees in it many French tendencies but after all they have gone deeper into the question than any other nation up to the present date, and their views are being adopted by nearly all European armies.

The new book contains only six examples of ranging; the old book tried to have an example of every possible condition, and when a target appeared it led to a scratching of heads as to which example applied to it. New Instructions for Practice:

The chief difference in these instructions was the sub-dividing the Practice up into separate progressive phrases. More a change in name than anything else as far as regards the Elementary and Gunnery Practice, but with considerable difference when we come to Tactical Practice.

To take the different portions *seriatim*—First we come to the Elementary Practice. This was carried out differently in the different camps; some carried on the old principle of calling it the Brigade Commander's day, which was like every other day except that the Brigade Commander was imagined to have set the scheme, while the two Divisions I saw carried it out in the following method as purely elementary.

The position was first occupied as a covered position by the battery commander who then fell out and became critic. A section only was used while the other sections and men from the wagon line formed up behind, and looked on. A junior subaltern ranged the battery on to a fairly easy target, advised if necessary by the gunnery instructor. As soon as the subaltern thought he had the range and fuze he stopped, the result was signalled in by the range party, and the whole of the detachments collected round the guns and were informed by the Brigade and Battery Commander of mistakes at their guns. The Gunnery Staff gave them their notes to help them.

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Then another subaltern was taken, who had to order a switch to a target and to range on it as before, young gunners being put into the detachments and criticism immediately after the series as before. Then the whole battery was manned and the senior subaltern perhaps ranged with "Collective" after making a switch, and again criticism with everybody round the guns.

By this method it was found that the mistakes which always take a place the first day were pointed out on the spot to all ranks, and it was found that it was unnecessary to mention them at the conference on other days, and they were simply sent round to those concerned. It is always the first day that so many mistakes occur and by pointing them out on the spot to the people who make them, there is less likelihood of their recurring. Criticisms at 3 o'clock in the afternoon are apt not to percolate to the lower ranks, but when mistakes are pointed out to the men on the spot they are less likely to make them again.

Gunnery Practice:

There was no difference between this and other years, a certain amount of tactics being introduced into the gunnery problems. In the two divisions I saw fire, it was left to the Brigade Commander entirely as to who should fire the series, from his knowledge of his officers and their requirements. In this respect, speaking purely as a personal opinion, I think we must be careful to give battery commanders enough shooting. It is a very dull business to train your battery carefully and then hand it over to others to do all the shooting. After all, they will, till they are killed or knocked out, shoot their batteries in war and the tendency now is not to give them enough practice in doing so. Of course one does not want to return to the retrograde days when the major had all the shooting, except one series carried out by the captain.

Targets were varied as much as possible and as life-like as one could make them, but as you know there are limitations in these respects when canvas and wood represent men and materiel. Effect was apt to be disappointing, but when you come to think that the average for a series can only be about 30 rounds, one cannot expect great effect, and as long as a battery commander has occupied his position and ranged quickly and accurately, and engaged his target or targets properly, it is all one can expect in peace time, and it is only in war that what one may call effective fire will be reached, and it is the man then who has carried out the above conditions best who can hope for success.

I will, later on, go into the different targets which presented difficulties and suggest methods for engaging them.

Battery Tactical Practice:

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We now come to the first real innovation. The camps vary very much in their possibilities of imparting tactical instruction, West Down and Larkhill being more from the nature of the ground adaptable than the others. On the other hand, Glen Imaal (where the system has been in force for the last three years), and Trawsfynydd, owing to their telephone arrangements, have special facilities not open to the others.

I will try and enlarge on the camp I was at myself. An infantry officer of the division the battery belonged to was told off as Officer Commanding the Force: the scheme was explained by the Brigadier-General and the position of the troops pointed out. The point at which contact had taken place, and where resistance was experienced was also pointed out, and the infantry officer and battery commander went off and consulted as to what was best to be done and the amount of artillery to be used and how to use it. Targets were then pulled up, if they were not there already, and firing commenced. As soon as one phase was concluded the Brigadier-General explained the situation and the procedure was carried out as before. Results were recorded as far as possible, as at gunnery practice.

The infantry officers who have hitherto been treated as spectators and kept on a high hill afar off to watch puffs of smoke, and who used to think how slow everything was, are now brought into the game. They hear everything, learn our limitations and possibilities and it was of interest to us to hear their views, and in my humble opinion was most useful to both arms. Infantry officers who were present told me they were very interested, had learnt a good deal and were only sorry that the camp was over. At the end of the practice there was the usual afternoon's Conference, but if the G.O. commanding the Divisions thought fit he also gave his criticism on the ground. So that gunnery should not suffer, the situation had occasionally to give way to targets, but they clashed very little. When telephones are completed on the ranges not now provided with them, there should be no clashing at all as the Brigadier-General will be able to have any targets he wants pulled up without the present cumbersome method of prearranged targets pulled up by signal.

In the "Instructions for Practice" it is stated that the G.O. commanding the Division was to draw up the scheme, but practically it came to the Brigadier-General doing it, as he knew the local conditions, danger questions, etc., and had to watch over the gunnery considerations.

Brigade Tactical Practice:

Brigade Tactical Practice was carried out similarly except the Brigadier-General of the Infantry Brigade to which the brigade is, what I may call, affiliated, was Commander and he and the Brigade Commander consulted together and worked in co-operation. There is not time in a lecture of an hour's duration to go into the tactical lessons, but one very big one came out and that was that in supporting the infantry attack in its final stages the greatest care must be taken by the gunner to avoid risk of hitting his own troops. Three times I saw shell fall absolutely on the spot described by the infantry commander as being the position of his troops.

In the amendments which are coming out, officers are directed when supporting an infantry attack to range with the longer elevation first when using section ranging, and to give such an interval between rounds that in the case of the first round being short the second can be stopped.

In supporting an infantry attack over-estimation of range must always be made.

Remember that if it is necessary to open fire on a trench it means that the men in that trench are firing at our people and therefore that our men are only about 1,000 yards distant.

Another big question cropped up several times in this question of close support, and that was that if the fore-ground in front of the enemy's position cannot be seen clearly, the artillery must at all sacrifice go forward to where they can see it.

I see in the late German Army Manoeuvres it is stated that the German artillery sacrificed themselves every time to bring off the close support of their infantry.

We have no information to date as to the support given by the Bulgarian artillery to their infantry in the assaults on the Turkish positions, but I hope we shall get it soon.

Divisional Practice:

Divisional practice was carried out by the whole of the 3rd Divisional Artillery, commencing with an Advanced Guard Action in which the 7th Infantry Brigade took part. Danger questions took away a good deal of the value of this practice, as the guns for safety reasons had to stop firing at the critical period of the attack. In the later phases, however, much interesting work was done in the way of allotting tasks to brigades and was successfully carried out. It is a question whether we can spare 14% of the total ammunition when so much has to be done, but this is for others to decide.

I should have said when talking of brigade tactical work that great difficulty was experienced with the allotment of tasks as all targets seemed to come up in the same zone, and the answer seemed to be the allotting of definite tactical tasks to the batteries. A most interesting translation appears in the December number of the "Royal Artillery Journal" which enlarges on this question

One point came out very clearly and that was that once a battery has been detached it is hopeless for a brigade commander to think he can allot it targets. It is out on its own with a mission and must do its best, of course informing the brigade commander when possible as to the progress of events. Collective Ranging:

Diverse views, needless to say, have been expressed on this subject, some taking a violent dislike to the method, others using it always. I think the word 'normal' is disliked but perhaps the idea is, 'that it would not have been tried at all,' by those who had made up their minds beforehand that it was no good. I am to a certain extent prejudiced in the matter, so like Agag, I must walk delicately.

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The advantages claimed for it are:

1. That lines, range and fuze are obtained at the same time.
2. That the fact of firing three fuzes at the same corrector gives you a mean to judge from, as it is unlikely that more than one out of the three will be a wrong'un.
3. That the rounds verify each other and no separate verifi-cation is required.
4. That there is information to be got out of every salvo, in-stead of as with a section perhaps losing one round and not knowing which it is.
5. That if you are lucky enough to hit off your range at once the moral effect is much greater.
6. That the obliquity of a target becomes evident.

A distinguished infantry officer last year who had to do with the experiments carried out was asked what he thought, and he answered, "I know very little of gunnery but as an infantry officer I should like to see my artillery ranging with 'Collective,' and I should hate to have the enemy ranging on me that way.

The opponents of the method put forward :

7. Extra expenditure of ammunition, and
8. The greater difficulty on the part of the battery commander in making the corrections.

It is has not been our experience this year that the expenditure has been any greater, and with reference to the second objection, battery commanders who began by disliking it, later on would not use any other method. There are occasions of course when it is absolutely wasteful.

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I saw a B.C. start 1,100 yards out in his range and creep up with 300-yard salvos until he got near his target. Having found out he was hopelessly out in his range he ought of course to have dropped 'Collective' and tried with a single round to get some indication of range, and then go on with his 'Collective.' B.C's forget that they can change from one system to another whenever they like. The inclination of B.C's was to correct their lines and forget to alter range and corrector. Probably with water-proofed fuzes next year it will be found much easier. The system has had one season's trial so we must wait.

It also came out that at a cavalry moving target 'Collective' ranging was not suitable. A rough bracket with a section was enough to go on with. I have stated as fairly as I can the merits and disadvantages of the system. If it turns out a failure and there is a desire after next year's practice to do away with it, no doubt the authorities will do so, but reading, as I have, the report of every Brigadier-General, Brigade Commander, and Battery Commander, I may tell you the consensus of opinion is that it has come to stay.

Various small amendments are being put into the F.A.T. as to the giving out of the orders during 'Collective' ranging to avoid delay. It is absolutely necessary that the guns should be fired at three seconds interval so that the B.C. will acquire the habit of looking for the rounds at that interval.

I have already stated that ranging on a target when in close support with 'Collective' the greatest care must be taken to overestimate the range to ensure being beyond our own infantry, and I have also alluded to the longest range being fired first with a section for the same reason.

Ranging on Irregular Targets and Natural Features:

As "Field Artillery Training" says, targets will seldom be parallel to the front, and difficulty was experienced this year in engaging these targets. The following is suggested as a method to do so; it was tried and found to be successful: Range with whatever method you wish, 'Collective' for choice, as in so doing you get your lines parallel during the first two salvos, guess the obliquity and go to battery fire correcting range and line of each gun by use of the word drop or add, thus: — Centre Section 3,500, Right Section add 200 yards, Left Section add 100 yards; Battery Fire 10 seconds, and during Battery Fire No. 1 add 50, No. 2 add 25, and so on. This obviates the battery commander having to keep a string of figures in his head and having to constantly turn round and apply to his penciller as to what range the guns are firing at.

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Enfilading should be done the same way: concentrate your fire, give different ranges to guns or sections, and correct at battery fire. At manoeuvres we talk glibly about destroying a target that presents itself to us in enfilade, but it is a difficult job and not a quick one.

Attack of Moving Targets:

In this, especially from under cover, progress has been made, but the failing here was in prediction. Officers forget the time it takes to give out orders, for the orders to be obeyed, and for the shells to arrive.

The 18-pr. too has its limitations when a target is moving across the front owing to the position of the wagon limber.

We had a moving battery of 6 guns which came down a hill obliquely for about 900 yards and I should not like to say how few effectives were scored. In shooting at game our inclination is to be behind the bird, and similarly with an artillery gun we are apt to shoot behind the target.

Another cause of failure at this particular class of target was the desire to go to gun fire before the lines were right and the B.C. was worried by a gun, or perhaps two, being right off the line. I was going to have mentioned this trouble later, but perhaps the present is the best place to allude to it.

45 Battery fire at two seconds is practically as effective as gun fire, and the battery commander can get his lines right and put them where he pleases, in fact his battery will answer the helm.

The old saying was "When in doubt, one round gun fire." We have all seen hundreds of rounds wasted at practice camps owing to this self-same order.

Engaging Infantry coming over an area before he reaches his Fire Positions: It is quite certain that infantry approaching a position, but long before they get to their fire positions (which are, as you know, those from which they will open rifle fire, and therefore not more than say 1,000 yards from our infantry), will be in what is called artillery for-mation, that is to say first in company columns, breaking up later into lines. If we do not fire at them in these formations they will come along all the quicker without loss of men and morale.

It is a difficult thing to engage these targets, and there are several ways to do it.

Having ranged on one spot, one way is to follow the enemy down the position with the fire of the whole battery; the second way is to fire at a spot where he must come to, and make that an inferno to come through; and the third way is to keep one section on the top of the area, one in the middle and one on the nearest portion.

50 No one can say that either method is wrong, but they all three want practising. One thing is quite certain and that is that infantry coming down, or going up, an area, can only be taken on by indirect laying.

Fire Positions:

Fire positions will require absolute accurate ranging to hold the enemy to his position to interfere with his fire. Reinforcements will pushed on to strengthen their firing lines and they may give opportunities and offer good targets when approaching.

Targets:

Targets have not varied much from other years. Infantry targets are the great difficulty. We tried pulling up little lines of columns in succession from the rear to the front, and then dropping them from the rear to the front. We tried pulling them up and leaving them up, and also letting them show for 10 seconds and then appear and reappear. They were only meant to show movement in the area. I don't say they were successful, but no one seems to be able to suggest any better. Engaging them obliged a battery commander to get the fire of his battery in to his hand, and a battery that did not answer the helm absolutely, was incapable of taking them on.

Flash batteries with the enemy showing his B.C. on a ladder were much in fashion, and our experience was that while the B.C. and his staff were always hit, the enemy's battery did not suffer much. Of course as I said above, we have not enough ammunition at a practice camp to get much effect. I hope next year that we shall have enough puffs and flashes to make them more realistic, as owing to the amount allowed it is difficult to keep up the enemy's flashes after the first few minutes, and they go off at too long intervals and make the location of the enemy's guns difficult.

It was suggested that we ought to show our own infantry as well as the enemy, and this will be done as far as possible.

Engaging Two Targets at Once:

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This has been found difficult and various solutions have been offered. Of course I mean from under cover, as in the open it is done by Section Control. Under cover the B.C. must command from the ladder if he is using one, while the section commander will use the telephone to the crest, or one will use the telephone, and one will use flags or two lots of different coloured flags will be used by the two men. Formalism is dangerous on this point, but the B.S.M. must see to these communications being arranged in accordance with the B.C's orders while the battery is in action. The telephone must always be laid to the crest whether the ladder is used or not, to which flank must be settled in accordance with circumstances.

Probably the best method is to lay it to the centre of the battery, so that if the telephone only is used it can work to the whole battery, and if the ladder is used and two targets are taken on, it can be used for the furthest section.

It was decided that if the B.C. is ranging on one target and has to engage a new one as well, that the B.S.M. should carry on with the old one, while the B.C. who knows the situation and the outlook, should take on the new one. If the B.C. is on his ladder, the section commander coming to take on a position will have to go up to the telephone station on the crest and command from there.

Occupation of Positions:

The same remarks came from all camps, that positions are not occupied as well or as quickly as they might be. It is a drill, whether you occupy a position in the open, under cover, or with a B.C. some way off, in other words a plotter series.

"Field Artillery Training" distinctly lays down that the observation station must be selected first and the battery position must be subservient to it, and the reason is a very good one, as the B.C. may be able to get only one place from which he can really observe his enemy and the situation. Having selected it and left his head-quarters to carry on with any necessary range taking, etc., he can then go down and select the position roughly for his battery, putting out his aiming posts or allowing the section commander who may have accompanied him, to do this part of the work and he will then go back to his place and all ranges, etc., should be ready for him. A very careful drill is required so that everybody knows what to do and how to do it in the quickest possible time.

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Every battery on every battery parade should drill under the stop-watch, and by laying down a standard for himself, a B.C. will soon find out where the delay is and will find out a means of circumventing it.

Say you take a standard of two minutes to occupy a position under cover and be ready to open fire, and thirty seconds in the open. You will probably not do it in that time but it is a standard to work up to. Horse artillery of course will do the latter a great deal quicker, but remember that five years ago they were accused of slowness, but I don't think they can be accused of it now; under pressure if you like to call it so, they have quickened up wonderfully.

Aiming Points and Parallelism:

The next two points which come up together and I think have caused infinite trouble this year, have been Aiming Points and Parallelism. The section commander has chosen a bad one, all guns have not taken the same one, parallelism is forgotten, level of wheels has been forgotten, and at once the B.C. has a more difficult job than he ought to have and no system of ranging will help him.

I know the objections in the equipment, and we have no oscillat-ing sight on the 13 and 18-pr. Q.F. We have been trying experiments at Shoeburyness to see whether there is any mechanical way without making calculations which are impossible in the field.

We cannot yet compete with the difference of level of wheels satisfactorily, except by the rough methods used now, till we get instruments, but we find that the guns must put on the angle of sight ordered, or zero if none is ordered, and level the bubble before the angle from the aiming point is put on; this at any rate saves the error of the angles being put on with the dials at different

The best way to get the guns on to the same aiming point is undoubtedly to leave the section commander's director on the aiming point and make the other section commanders look over it.

Marking for Line:

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Marking for line has not been satisfactory, and probably the best way in nine cases out of ten is to mark where the flanks of the battery will rest. It has been found that far better line has been obtained this way, and this method has been suggested as an amendment. I was asked this year, was it permitted, and my answer was "the book permits practically anything, but if you depart from what is advised you must be prepared to justify it in case of failure." Information, too, was not sent back to the batteries and in consequence there was much delay after the guns were in action.

Advancing and Retiring:

Page 333, "Field Artillery Training," has been found confusing, and it is to be hoped that when the work comes out as a permanent work that it will be made clearer. We have had a class of N.C.O's at Shoeburyness lately, and although it was thoroughly explained to them they made a terrible hash of a question in an examination paper.

Position of assembly seems to have been the stumbling block.

This should be pointed out as only to be used when it is necessary to run the guns back by hand. It is really the place where order is created out of disorder so to speak. Each gun has been run back to a different place and the position of assembly is where they are collected and brought into hand again either for advance or retire-ment.

In a retirement first-line wagons, under a N.C.O., were found to stray about in a way which they would not be able to do on service, and in future the B.C. if he wishes, may keep them with him.

Battery Head-quarters:

Battery head-quarters have become swollen to an unhealthy ex-tent. Field Service Regulations lay down the number allowed in War Establishment, and the sketch I have here is a suggestion to use the exact number allowed and no more.

You will notice I have suggested a ground scout to do penciller for the B.C. His duties as ground scout have ceased as soon as the guns are in action, and he is available as messenger and writer down. A habit has sprung up of the B.S.M. being used to write down the B.C's orders. He has too many other things to do and just when he is required to be arranging communications, etc., he is writing ranges, corrections, etc. He will nearly always be employed to pass the orders. The B.C. cannot turn round and shout to his battery. His attention is immediately attracted by seeing, say, Sergt. Brown com-mit some atrocity when he should be watching his target. He has got quite enough to do to keep the figures in his head and rap out his new orders quickly without having to strain his voice and shout and wonder if the order got down. The B.S.M. usually has a stentorian voice and it will be the same voice sending down orders whatever officer is commanding.

What has come out at every practice camp, is the slowness in giving out new orders. It will be of no use having guns that can fire 50 rounds a minute if we cannot quicken ourselves up to give the orders to the guns. It ceases to be a Q.F. battery if the B.C. is always going to turn round and ask a man behind him what was the last range and corrector. I think every battery should have even the most elementary form of miniature range and two long iron rods with heads painted white one side, and black the other, are as good as anything else, and with wooden blocks for targets.

Ladders:

Ladders were allowed this year, and some ingenious ones, and some dangerous ones appeared. As you perhaps know the principle is recognised and firms are now sending in designs. The idea is to have a collapsible ladder, shielded with steel plates to carry range-finders, directors, etc. By using ladders you get voice control, but if they are not placed carefully, every B.C. perched on his ladder be-comes a conspicuous target.

We saw them used this year very often when they were un-necessary, because like every innovation it is apt to be run to death.

If there is a dark back-ground of trees, or suchlike, the ladders will not be seen, but placed as a sky-line target they will, in my humble opinion, be deathtraps. Of course they are a necessity, as on a modern battle-field batteries will not be able to spread themselves out as in a practice camp and the so-called plotter position will be as rare as the dodo.

Meanwhile we have got to learn to use them. This year they were apt to follow the B.C. everywhere, like Mary's little lamb used to follow Mary. It is suggested that they should accompany the headquarters when it goes forward to occupy a position. As a side issue, which this brings up, I was asked by a General Officer to draw atten-tion to the fact that there are two reconnaissances, one by the B.C. with the Force Commander to determine what to do when he goes on alone, and one when he has decided to occupy a position and re-connoitre for what you may call his technical occupation.

Another point which came up this year, and this applies particu-larly when subalterns are distributed with their sections, and that is how to do without instruments. We have got accurate instruments, but how long will they last and how many are there? I have seen great delays because a section commander had lost his aiming posts. Well, anything will do to mark the line, his hat, his handkerchief, or anything that he has. A No. 7 dial sight is as good as a director, and parallel lines of fire to a named gun gets all the others on to the line.

The angle of sight is troublesome but every section has a field clinometer, which can be set level on the ground, or on a blanket to get a zero point, and graticules on his glasses will do the rest. Any good map can be used for determining the angle of sight if the officer will remember the old gunner's rule "reduce the difference in feet to inches and divide by the number of hundreds of yards in the range," which will give the minutes of elevation or depression required.

Registering:

This was the first year in which registering was seriously attempted and the results were not eminently satisfactory, probably owing to the fact that there are very few prominent spots on our ranges and ammunition was occasionally grudged for the purpose.

The following methods were tried :

9. sing one gun and swinging over all the others with it.
10. Using a section and swinging over all the others with it.
11. Using one gun and leaving the others on the original line.
12. Using a section and leaving the others on the original line.

I suggest that either of the last two are right, but the important point to be considered is the record of the registering. I think the B.C. should make up his mind what points he is going to register and number them or letter them to his penciller as follows, beginning from the right:

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13. Top of wood ... degrees right.
14. Right edge of triangular wood ... degrees left, and so on.

He can range with each section in turn if he wishes, putting them back on to the original point after he has done with them.

Then when a target appears he will simply ask his writer down for, say, particulars as to "C," etc.

I think in registering he will only bracket A, B, C, etc., roughly.

Direct for Line and Indirect for Elevation:

Direct for line and indirect for elevation was found to be a fail-ure on nearly every occasion that it was tried. The name is misleading; it is really indirect laying, and the introduction of the word direct confuses the layer and they were found laying with their telescopes both for line and elevation on anything they saw.

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We had an example one day when one gun of a section laid on the top of an area, and one on the bottom, to the discomfiture of the battery commander. Several times one section laid with open sights, one with telescopes and one used indirect laying.

It is simpler to have nothing but direct and indirect—direct when the target can be seen clearly, with open sight or telescope, and in-direct on all other occasions. Reservists will rejoin the ranks when the bell rings for war, and the simpler everything is, the better.

Training a Battery:

The batteries come up admirably trained but it is very difficult for a battery commander to train himself. Some years ago, when commanding a battery in Ireland, I saw a Lieut.-Col. training his brigade in the following way, and I made up my mind that if ever I commanded a Brigade I would do likewise. There appeared in Orders : 200th Battery: Training. 201st Battery: Find horses. 202nd Battery: Finding fatigues and targets. All officers attended and the B.C. and his officers were given every sort of problem, and all officers of the brigade listened to the criticism. One knows how when training a battery one makes the targets fit one's position instead of vice-versa, the B.C. himself gets very little benefit out of it.

No. 7 Dial Sights:

No. 7 dial sights were used in some brigades and when they know how to use them, under cover work, and work in the open is going to be much simplified. Some brigades bravely used them although they had never seen them till arriving in camp and they will reap the benefit of their year's experience. The innovations of the year did not affect howitzers and heavies, except that at tactical shooting the slowness of the howitzers militated against their taking on movement, but their value for covering infantry from covered positions at close ranges was apparent.

Various small points are being considered to quicken up the service of the howitzer and I hope by next year the lanyard and the rammers will have been relegated to the limbo of the past. Of course they suffer under the grievous disadvantage of having to range in degrees, and the howitzer commander has to think in four dimensions like an airman.

Aeroplanes:

85 Efforts were made to carry out artillery work in connection with aeroplanes. Ammunition was granted and a Committee told off to carry out the experiments, but as you know, the aeroplanes only like going out in the morning and evening, and we could only shoot be-tween 9 a.m. and 3 p.m. Still we did a certain amount. As you know the French method is to put out two white cloths on the ground, one in front and one behind the battery that is firing, and when the aero-plane gets near, a salvo of 4 or 6 rounds percussion are fired with the same elevation, and immediately afterwards another salvo, at say 300 yards interval. The aviator has a card which he marks with the position of the salvos with reference to the target, which he drops, and then flies away again and the procedure is repeated. Great difficulties were experienced in getting the information down to the ground and various experiments are under trial. We also hid bat-teries for them, which they always found, and we also had ranging with puffs which they reported correctly. I hope next year that we shall be able to do more, as they are probably going to alter the whole question of concealed positions.

Questions have been asked as to the effect of the abolition of classification, and in answer, I cannot do better than quote verbatim the following extract from the "Annual Memorandum of Training," issued by the G.O.C.-in-Chief, Eastern Command, which to my mind is an excellent answer:

He says, "The General Officer Commanding-in-Chief has been gratified to find that in accordance with his expectation, the abolition of classification has been attended by no loss of keenness in officers or men. Under whatever system practice is conducted, it is impossi-ble for a brigade or battery to complete its annual course without affording to its superior commanders ample evidence of its efficiency for war or otherwise. Commanding officers need consequently be under no misapprehension as to their respective merits being un-appreciated, or their weak points escaping criticism."

This finishes my remarks, and all I have to do now is to apologize for the inordinate length of my lecture. I once heard the cynical remark, that in this world there is nothing new, nothing true and nothing matters. Well I am afraid that nothing I have said is new, it is nearly all true, and we all know that it matters very much.

Discussion

CHAIRMAN: Has any officer any remarks to make, or questions to ask the lecturer?

90 LIEUT.-COLONEL BATTISCOMBE: Colonel Bingham made a remark about the use of instruments, and he said that they were very apt to get out of order. I do not know; I am rather more optimistic about them, but if they are going to get out of order as quickly as he thinks, I think we had better do without them altogether. I think the reason why we are not inclined to

try to do without them is because we are always afraid of hitting somebody on the range; there has always been that fear of firing into somebody who is exposed on the range. Otherwise, no doubt if you have a reasonable map and a protractor, you can get a good line without any instrument at all, and having fired one shell you can get your line from that. I think perhaps it would be a good thing if now and then at practice we were deprived of some of our instruments, so that we should have to get along more or less without them.

Then as regards the howitzer, Colonel Bingham was talking about ranging in yards, and I hope we shall get a yard scale before long. At present it is a matter of expense. It adds to the difficulty of procedure to be obliged to give elevations in degrees, particularly if one makes a bad shot at the original range. It is all right if you get near it, but when you get an error in your first range of 1,000 yards or so, and are in a hurry, and you do not look at the range table, but try to make a shot at what the next elevation should be, you are apt to get into trouble. I think one does rather want to simplify it. Then the Lecturer was talking about taking on two targets at once from a covered position. I think that is really the most difficult job we have to tackle, because if you have two people observing from the same point and trying to send down orders to the battery you are apt to get muddled up. I think one wants, so far as possible, to try and separate one's two observing stations if one can. Very often it is very difficult to get two observing stations separate. If you have any idea that it is likely to occur, the best thing would be to hold up one section so that it could be placed a little way away from the rest of the battery. If you have the whole six guns together and you try to send an order down to the battery there is apt to be confusion; and with a howitzer battery it is more difficult than with a gun battery because you are generally further away from it.

GENERAL PHIPPS-HORNBY: The lecture that we have heard this afternoon, I certainly think is one of the greatest interest that we have ever heard in this theatre, and I am sure it will have a very important effect upon the Practice Camps for next season. I must say that before I came here this afternoon I was very much afraid that I might hear all sorts of things against which my spirit would rebel. I have had many altercations on previous occasions with the lecturer and I must say I was very much afraid I might hear some of those things over again. Whether he has come round to me or I have come round to him I will not say, but I was very glad to hear many of the remarks he made this evening.

As regards the elementary system at Salisbury Plain I think the idea is an excellent one, and I intend to put it into practice myself next year. I admit that I have not tried it myself, but I am sure that it is a great improvement on anything we have done before.

As regards the battery commanders firing, I do not think they do fire enough ammunition, for the trouble they have in preparing their batteries for the Practice Camp. Personally, I do not think we should give a Major who is just going to be promoted to Lieut.-Col. more than one series, or even as much as that, because he has practi-cally come to an end of his time as battery commander, and those rounds that he fires will be of far more use to somebody else in the junior rank than they will ever be to him. At the same time I think that junior majors and senior captains ought to have a great deal of firing, and junior subalterns and second-lieutenants certainly ought to have one series each during the time of practice.

Then I go on to another point, about which I was afraid I might not agree with the lecturer, and that is the tactical application of fire; but he has taken all the wind out of my sails, as sailors say, by telling me that he is an advocate for range parties. I do not care, myself, what system of practice you have as long as you have range parties, I quite agree to that, but when I was told last year that the system of tactical application of fire was that they fired four shells at the same elevation, and then fired four more shells very quickly at another elevation, and there was nobody out there to see what effect they were having on the target, I said, "That is not for me; I do not agree with it." But now if a range party is out there I quite agree, though I still think tactical application can be quite well taught with-out firing ammunition. But there is one point about these tactical days which is very important to infantry commanders. I do not quite understand how they did it on Salisbury Plain. I have asked the authorities time after time if they would supply cobs for the infantry officers. Infantry officers came down to camp to witness artillery practice, and they can do so from one position; but batteries sometimes advance more than three miles, and they are supposed to be able to see what goes on in the next series. It is not fair upon the infantry at all; they come down there to co-operate with us in the practice camps, and I think they ought all to be mounted, and to be able to go as fast as the artillery do. That is a point that has been put into my practice camp report this year, and I hope that before the next camp we may find a certain number of cobs told off for the use of infantry officers.

Then I do not quite understand why these divisions for practice at Salisbury Plain this year, extended their front four miles. Certainly the attacking front of an English division now is not much more than a mile and a half, and, if you have got your artillery confined in that space, it is enough, and, if it is one division by itself, you can cover the whole country. But probably when we fight a battle in the future we shall find ourselves with one or two divisions in line, and in that case I fear that the centre division will not be able to get be-yond the extent of their division, and, the attacking front of the division being a mile and a half, you would have to get your 76 guns into that space. So I think that if you go and extend three or four miles you are doing something that you are not likely to be able to do afterwards.

Colonel Bingham says that field firing is a frost, and I quite agree with him; it is no good to anybody, it is a waste of ammunition, and I think the less of it that is tried the better.

Now I come to our old friend 'collective ranging,' and I must say I do not object to collective ranging, except that I do not think it carries out the idea with which it was introduced. If you do away with the word "normal" out of the book you will have met me a good distance, because the system of collective ranging always seems to me to be a waste of ammunition. I think the lecturer really gave me something to get hold of when he was talking about collective rang-ing, because I understand him to say that when you fire three shells together, one will always show you where it is when it bursts, which means that your fuzes are very irregular, or, if it was not for that nothing really to check our firing by. So I think that if we are going to have targets coming down hill it ought to be a gradual approach from the rear to the front, or from the front to the rear retiring, and leave the targets standing up till the whole show is over.

The lecturer has told us that the No. 3 director was the best and most important thing that could be made; but I am sorry to say on that point I do not agree with him. The best I have seen was one made by Colonel Scott, at Aldershot and Farnborough. I do not believe that anybody could make a mistake with it; I wish we had it introduced into the service instead of Mark III. With Mark III you cannot take the angle of sight within 30 degrees of the battery. Of course that will not come in on any flat places, but it certainly will come in if you get among hilly ground. I hear that the lecturer does not like direct for line and indirect for elevation; but it seems to me that if you are firing at a moving target you can get much more accurate fire by that means than by telling the men to lay on some particular point and then making your deflection from that. But I suppose they have had a great deal of experience down at Salisbury Plain, I only saw the batteries of the 4th Division firing, and I must say that I came to the conclusion that direct fire for line and indirect for elevation was rather a good arrangement.

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Those are the remarks I have to make. I hope somebody else will make some remarks, because if Colonel Battiscombe and I are the only two I do not think we shall have much discussion. I will only conclude by saying that we are very much obliged, and I am personally, to the lecturer for the very interesting lecture he has given us. (Loud applause).

MAJOR BELCHER: As regards taking on two targets at once with one battery, I should like to ask the lecturer whether any of the batteries which practised this year were split up into half-batteries for practice in the way Capt. Wynter suggested in his article which appeared in last month's Journal.

Another thing the lecturer spoke about was the importance of drilling the staff of the battery. I should like to make a suggestion. We have done away now with competitive practice, but would it not be possible to have, instead of that, competitive drill, I should think it would not be very difficult to design a competition which would test the drill of the gunners, and also we might have another test for the staff in laying out lines of fire, giving out orders and that sort of thing.

CAPT. W. S. D. CRAVEN: About direct for line and indirect for elevation, I should like to ask the lecturer whether he means that we may now use our telescopes or open sights, which most of us prefer doing, at fleeting opportunities in the open. Or must we lay at them indirect with our aiming point?

LIEUT.-COLONEL BINGHAM: My view is that if you mix up the names direct and indirect in one order, you get confusion. By all means use your telescopes if the target is suitable and sufficiently visible.

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MAJOR COSSET: There is one point I should like to raise about the delay that sometimes occurs between the receipt of an order by the battery commander and the battery coming into action. On one they would burst in a horizontal line. If that is so it is no good giving you any more accurate fuzes. You are going to have only water-proofed fuzes next year, and if you fire three at a time and they are really accurate, and all burst behind the horizon, you will have lost the lot and will have wasted two shells anyhow. I think that is a fair argument. If you are going to have bad fuzes, then fire them certainly in threes; but if you are going to have accurate fuzes I think it is better to waste one at a time than to waste all three to-gether. I know that last year there was a great deal of argument about collective ranging being the normal system; that is what we were told at Salisbury Plain. When we were trying the 4-gun batteries and guns with the new recoil arrangements, I could not see for the life of me why it should be normal, and I do not see it now; because a normal system is one that you expect to use five times out of six, and I do not think there are more than two occasions—I think there will be only one when you would use collective ranging. I do not think you would use collective ranging at infantry in a trench. I do not think you would use collective ranging at guns in action. Why should you? If they are coming into action certainly use collective ranging on the chance of getting them knocked out before they come into action, but, if you are going to use collective ranging when you are firing at troops moving, it looks to me as if you were going always to imagine yourselves in a position of defence, and I think, considering all we hear to-day, when we go to war we shall go in for attack-ing; and for that reason, as well as several others, I do not fancy collective ranging. We tried it last year at Okehampton on many occasions, and one major from the 4th division went down to see the practice at Salisbury Plain, and then came down to Okehampton, and he thought he was going to do rather well; but he only tried it once, and then I had to order him to do it or he would not have done it again.

The difference I think is that at Salisbury Plain your angle of sight does not come in much, but at Okehampton the angle of sight is one of the most important parts of gunnery, and, until you have some system of getting the angle of sight absolutely accurate, and until you have got your fuzes more accurate than they were, I do not think collective ranging is of any use in a hilly country.

I asked one or two officers whom I met who had come from Salisbury Plain, what was going on there, and they told me that only two officers were really keen on it; one was Colonel Horne, and the other was Colonel Bingham.

LIEUT.-COLONEL BINGHAM: One must father one's own child.

GENERAL PHIPPS-HORNBY: Then the lecturer was telling us about taking on targets coming down a large slope.

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I think at a practice camp what you want to do is really to go in for accuracy in shooting. I do not think if we cover a hillside with targets, which bob up and down every ten seconds, it is good enough to teach accurate shooting. There is no chance of checking the lay-ing and men soon learn to ignore the importance of accurate laying. I think the targets ought to remain standing up and then it is some test really of where your guns are being laid. If the targets fall there is nothing to show at what each gun has been fired and we have occasion at the artillery training this year; it took a quarter of an hour for the advance guard battery to come into action after the receipt of the order, and in a practice camp it takes anything from ten minutes to an hour and a half, and that seems to me quite useless. I should like to submit that if possible the battery, instead of going to a ren-dezvous, should occasionally march off from camp and not to rendez-vous, and the battery commander should receive his orders on the move, while the battery is still on the move, so that he cannot halt his battery and spend a long time in explaining the situation and his intentions in detail to his battery, which he could not do on active service without the troops he was accompanying losing the support which might be afforded by the fire of his battery.

MAJOR HOARE NAIRNE: I should like to put in a plea for the section commander, whose section is detached from the battery, and who has to shoot from behind cover. Makeshifts will do much for him, but they will not give him the angle of sight. He needs a pocket angle-of-sight instrument.

I know that such instruments have been issued to batteries, at any rate one was sent early in this year to the battery I then com-manded; but only one instrument has been supplied for each battery, it is nearly always required by the battery commander, and the com-mander of a detached section generally has to do as well as he can without an instrument. At Salisbury Plain that does not very greatly matter, but in a hilly country the difficulty is far more serious. A pocket instrument should be supplied for each section com-mander, as well as one for the battery commander; if it were only a clinometer it would be a great help to the commander of a detached section.

LIEUT.-COLONEL BINGHAM: He has a clinometer on each of his guns.

MAJOR HOARE NAIRNE: I meant the Watkin clinometer which we used for sketching. This instrument is now obsolete as far as field sketching is concerned, so there are probably a number in store which would be available.

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LIEUT.-COLONEL BINGHAM: I understand.

GENERAL SIR WILLIAM FRANKLYN: I came down this after-noon to learn rather than to speak, and I cannot enter into a great part of the lecture, but I should like to put in a plea for the divisional day which the lecturer rather tore to ribbons.

To begin with the division day: I was told that two brigades could not fire together on Salisbury Plain, but I eventually got a division day, and the next year I was very sorry to let it go by. At any rate it gives some sort of opportunity for the brigadier-general to exercise his command, which he never has at any other time of the year. At the same time it carries me back to the time when I was also asking about the swing of the pendulum being too far when all the subalterns fired their batteries with the major standing by. I was told that they were the majors of the future. That was the answer given me then, and I suppose it would be the answer given me now. I do not think there is any other part of the lecture I can possibly touch upon with any degree of confidence.

I should like to emphasise what General Phipps-Hornby said about the British officer: his one idea of tactics is to take up a position behind our defences. I am very glad to hear that that is being looked down upon in some places at any rate.

LIEUT.-COLONEL BINGHAM: Colonel Battiscombe asked about ranging in yards, and as he rightly says, it is a matter of money, and we must sincerely hope that in time it will be put right.

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With reference to what he said about taking on two targets simultaneously. I should like to combine my answer with the answer to Major Belcher, who asked what was the result with two half-batteries. The War Office asked Brig.-Genls. to report this year, in view of the introduction of collective ranging, as to the feasibility of dividing a battery into two 3-gun units.

My answer is that it was done with success several times this year, that there is nothing against it, and nobody can prevent you doing it; the book does not forbid it. You might have to divide your battery into two units of 1 gun and 5 guns, so why not into 2 of 3; it does not break up your section organization. This present book allows anything as long as you succeed. If a battery commander knew he was going to have two targets at once, he would probably, as Colonel Battiscombe suggests, arrange his battery into two distinct units to start with.

Then General Phipps-Hornby spoke about range parties. On most of the camps the question is simple, as the range parties are on the hillsides. At Salisbury it is more difficult, but we hope by next year to ensure observation of every target. Experiments are being made with a periscope by means of which men will be able to sit in their splinter-proofs and observe the fire.

General Phipps-Hornby's next question is re: horses.

Horses are provided on the Plain and a general service wagon was taken out and put near the battery commander, so that the infantry officers were able to hear what was going on.

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As regards what Sir William Franklyn said about divisional practice, I was looking at that more from the point of view of the ammunition. I know the great value of it, but what you have to look at when you have only 600 rounds, is how you can use the 600 rounds most beneficially.

General Phipps-Hornby criticises collective ranging and the only answer I can give, without discussing the question for a long time, is that by it I think range and lines and fuze are obtained quicker than by any other method. He also made some remark about the angle of sight affecting collective. It does, but now that you have an instrument that takes the angle of sight within two minutes, I do not think that is a difficulty that ought to hurt you very much. Still these things are a matter of opinion.

Then General Phipps-Hornby talked about the No. 3 Director, and I am bound to say that it is a very good instrument. For years people clamoured for an instrument to work the angle of sight from the flank; and, in consequence, some eighteen months ago, this in-strument was introduced. Except that it does not take the angle of sight directly in rear or in front, it does do what is required. It is, however, so extraordinarily delicate that it is a question how long it will remain serviceable.

What Major Gossett said is very sound, that you should try to make the situation more real by giving the battery commander his orders when he is actually on the march, instead of making the situ-ation with a set piece so to speak. I think the idea is good, and we will try and see what can be done to carry it out.

As regards the frontage of the divisional artillery at the 'divis-ional day,' I am afraid I made a mistake in my statement of 3 miles. Colonel Hall who commanded a brigade and who says he found it most interesting, tells me that it was only on a frontage of 1_ miles. I am afraid Major Belcher's idea of the competition drill is not very feasible, but somebody may suggest a method some day which will meet his views.

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I think I have answered all the questions to the best of my ability.

CHAIRMAN: Sir William Franklyn, ladies and gentlemen, I am sure that I am right in saying that we all endorse what Genl. Phipps-Hornby has said regarding Colonel Bingham's lecture, and the interest we have taken in it. The lecturer has I think touched upon all the questions which have arisen at the camp at which I was present last summer, and has discussed them most fairly.

With regard to collective ranging, we all understand that it is on its trial. It was put into the new "Training Manual" because it was thought that by its means, effective fire would be obtained quicker than by methods previously authorised. That is its only justification, and if it fails to do what was expected of it, it will, I am sure, have to be given up. It will, however, certainly as far as I know, stay on for another year at least, and perhaps if General Phipps-Hornby carries out the practice of the batteries under his command at a less hilly range than Okehampton next year, he may form a more favourable view with regard to it. He mentioned that he was told that there were only two people on Salisbury Plain who were agreed to be very red-hot advocates of it. I must add one to the number, that is myself. I think it was most satisfactory and successful, and I may say that a considerable number of men who came there very much prejudiced against it, went away saying that they entirely concurred that it was a good system. As regards the word 'normal' I do not think it is of very great importance when everybody knows that they have absolute latitude in departing from the normal system when they consider they are justified in doing so.

Every year a large number of suggestions are made for improv-ing our methods, and I think it cannot be too strongly urged that in making such suggestions we should aim at simplification in every possible way; at present they are getting very complicated. If we take our laying alone, the battery commander has to give his orders regarding the method to be employed. He may order direct laying on the objective with open sights, or with telescopes, or with the dial sight; or he may order indirect laying on an aiming point through the dial sights, which may be further complicated for the layer by the necessity for using auxiliary aiming points over the open sight, or again he may order aiming posts to be used. Finally he may order direct for line and indirect for elevation. There are so many things that a man may do, and it all means extra things to be thought about and extra things to be explained, with the possibility of mistakes arising.

With regard to the method of laying known as "direct for line and indirect for elevation," the order for that method was given several times during the practice at Salisbury Plain when I was there, and every time something went wrong. Personally I should like to see it drop out of the book, but opinions are not unanimous on this point.

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There is one part of the shooting this year that I do not think has been very much touched on, and that is what we call tactical practice.

The object of this nature of practice is, as we all know, to accustom officers who are exercising command over forces of which artillery forms part, in giving orders to their artillery, and to let them see the practical result of the orders they have given. At the same time artillery officers have the experience of receiving orders from officers of other arms as to the tasks which they are to carry out in order to further the commander's plans, while they are made to realise that they have not got the whole battlefield to themselves, and that their choice of positions for their guns is governed to a considerable extent by the dispositions of the other arms. When infantry brigadiers were called upon to take command they were generally given an imaginary infantry brigade of their own and an artillery brigade also, but more junior officers of infantry were given a smaller force of infantry and a battery. In my opinion great bene-fit was derived from this nature of practice by the officers of all arms, and it gave rise to most profitable discussions. Some of the most important lessons learnt were the limitations of artillery, and the first that occurs to me is connected with the time we take to make our preparations before we can open fire. I do not think it is always realised what time we often require to carry out our own reconnaissances, and bring our guns into action, and that meantime if the infantry advance commences it cannot receive artillery support. Another limitation I may mention is the restricted front which a battery can effectively cover, namely 1 times its own front, without sweeping, while if sweeping is ordered the intensity of fire is reduced. I think that it is of great importance for the commander of a force to have ocular demonstration of what guns can and cannot do. Another question which gave rise to useful discussion was that of the expenditure of ammunition in supporting long infantry advances; the point of course being that we cannot maintain a rapid rate of fire for any considerable time.

The extent to which the co-operation of artillery and infantry has been discussed during recent years has cleared everybody's minds as to the orders which a commander must give to his artillery, for he must give them orders just as he gives orders to his infantry. He has to differentiate in his own mind as to what are technical and what are tactical questions. For instance he would not give orders as to whether ranging was to be carried out by the 'collective' or 'section' method, which is entirely a technical question, but the occupation of a concealed position by the artillery might be an essential part of his general plan of action, and if so he must give orders regarding it. Again he may have to give orders as to when fire is to be opened.

Colonel Bingham referred to the Bulgarian artillery, and I may mention that there was a most interesting telegram on the subject in 'The Times' of yesterday (December 4th), from the special correspondent with the Turkish army, in which he describes the co-operation between the two arms as not having been very successful. The telegram is most interesting reading.

With regard to the question of shooting over an area, I feel convinced that, having in view the desirability of simplicity of method, we would do well to employ exactly the same method whether we fire from an open or concealed position. The objective may at times show itself distinctly, but in real life, it would certainly as it advanced or retired disappear behind ridges, or into hollows in the ground, and direct laying would then be quite useless.

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With regard to flash batteries, they are a target at which we do a good deal of practice, but what are we going to do if when we go to war there are no flashes, and our infantry are under heavy artillery fire. This is a point we ought all to have in mind, and which we ought to do our best to bring to notice. The solution appears to be the employment of observers in air craft to locate the enemy's guns, and observe our fire, but in order to be of any use this requires much practice in time of peace.

Observation wagons have been referred to by the lecturer. I am not aware that any pattern has been finally approved for adoption. I think myself, and I am sure that many officers are of the same opinion, that any observation wagon introduced into the service requires a shield and ought to be able to carry two people on the ladder. I now only wish in your name to thank Colonel Bingham for his lecture, which has given us all food for thought and a great deal of instruction. I am sure we have all enjoyed hearing it, and I must congratulate him upon it.

3: "Lessons to be Learnt from the 1913 Practice Camps"

By Colonel the Hon. F. R. Bingham, R.A.
Brigadier-General H. S. Horne, R.A., Inspector R.H. and R.F.A., in the Chair.
Source: *Journal of the Royal Artillery* 40:11.

THE CHAIRMAN: General Snow, Ladies and Gentlemen— On the 5th December last year in this Institution, Colonel Bingham confided to us the impressions and experiences of himself and his Staff formed during the practice season of 1912. He impressed upon us the points which called for our attention, and he indicated the direction in which the Instructions for 1913 would probably trend. The lecture was received in this building with enthusiasm, was repeated elsewhere, and undoubtedly proved of the greatest value to the Horse and Field Artillery at large. The Committee of the Royal Artillery Institution recognizing that fact has invited Colonel Bingham to come down here again this evening and open his mind to us regarding the Practice of 1913, and he has very kindly consented to do so.

May I be allowed to express the hope that after Colonel Bingham has delivered his address, those who feel themselves competent to comment on any remarks he has made will do so in order that we may have a good discussion, for undoubtedly an illuminating dis-cussion puts the crown on an interesting Lecture. (Loud applause).

THE LECTURER: I must apologise for lecturing two years' running on the same subject, and I may say I did not want to do it again, but I was told that it was useful and filled up gaps that must necessarily exist in official publications, so I consented. I am afraid there is very little now to talk about. F.A.T. is coming out in its permanent form as soon as it can be corrected and got ready; the amendments which will come out with it are really only details which were shown to be wanted. I will first shortly discuss the systems of the year and then go on to gunnery details which are really the pickings of the Camp Commandant's Reports and our own experiences at the different camps.

Elementary.

Elementary was carried out in most camps on the lines suggested last year. One camp did not like it and described the method as Kindergartenish—so let it go at that. It is open to the Camp Commandant to do it on whatever lines he pleases on the understanding that the elementary day is for the instruction of the young officers and the young soldiers.

At Lark Hill we had a quick-firing test with one gun in battery to show the men what continuous quick fire means. The quickest rate obtained was 22 rounds a minute, firing for half a minute. The rank and file took great interest in the test.

The 3rd Division fired their elementary on the Plain before going to their camp, and a Howitzer Brigade at Aldershot a few rounds on Colony Bog. The system is excellent, and it is a great pity that there are not facilities for everybody to carry their preliminary as did this Brigade.

The 5th Division fired their elementary at Glen Imaal, and went back later on and fired the remainder of their ammunition.

Gunnery.

Our great difficulty is still in producing proper targets to represent movement. I sometimes think we do not take enough time to explain to the Battery Commander what the target represents.

We tried on Salisbury Plain, which is the only camp where you can have real movers, small columns to show advancing and retiring infantry, but it was not entirely satisfactory, as in real life if we saw anything we should see many rows and batches of columns. Some people think targets are unnecessary, but personally I am of opinion that dummies should be put in every standing or natural target so that effect can be counted.

Effectives are not worth talking about at an irregular target, as the opinion of the Range Parties is worth nothing unless they are parallel to the target.

To give some idea of the material required and the labour involved, I may tell you that West Down and Lark Hill had each 85 miles of wire laid out on the range to work the different targets, even then one felt that the targets did not represent to the Battery Commanders what we meant them to represent.

Tactical Shooting.

Do not let anyone think that tactical shooting need in any way interfere with instruction in gunnery. It ought to add an extra interest in the latter, and every series fired at tactical practice should be as closely criticised from the gunnery point of view as from the tactical. As a battery never fires more than about 100 rounds in a day, the number of situations should not exceed, say 4, giving that number of gunnery series enabling ranging to be carried and effect to be obtained. The Infantry and Cavalry Officers who now take great interest in our shooting have ample opportunities with this number of situations of visualising for us the movement of their own arm, and so helping us as far as can be done without the presence of actual troops.

Divisional Field Firing.

The Divisional Field Firing of the 3rd Division with the whole of the Infantry of the 3rd Division was intended to show the infantry the effect of artillery fire, and at each phase they were placed in a position to observe the fire. It was also intended to practise co-operation, but as they were not allowed to advance under artillery fire not much was learnt in this way. Nobody will take the responsibility of the risk, although I understand it has been done in India. A suggestion from Ireland to employ special shell with a blowing fuze is not practicable from financial reasons and from the difficulties of turnover. At the 3rd Division field firing the practice, from the point of view of allotment of fire, was very well done. Tasks were allotted to batteries, but they were also allotted zones in which targets, although they did not affect that task, were the objective of the units to which that zone was allotted.

Conferences.

At Lark Hill the plan was tried of the Brigade Commander attending at the Camp Commandant's preliminary Conference instead of giving his criticisms first at the General Conference. It has always seemed to me absurd to ask a Brigade Commander to publicly criticise his own Majors whom he has trained. Needless to say, opinions vary a good deal on this point.

Occupation of Positions.

And now to get on to the occupation of positions and technical gunnery questions connected therewith.

Times throughout had improved considerably, showing that the stop-watch had been extensively used, but various points came to notice, which in our opinion would have helped matters, and about which, of course, there are differences of opinion.

I want to go quickly through the procedure of occupying positions, under cover, in the open, and in semi-covered positions. Of course there cannot be any real sealed patterns, but here are sample ones for what they are worth.

Let us take the covered one first:

Covered Position.

The C.R.A. and O.C. Force make their reconnaissance, and it is decided that the guns are wanted in action with complete cover. The B.C. has had no one with him during this reconnaissance but his trumpeter and director man. Cavalry Brigadiers only allow one man with the B.C. R.H.A. The remainder of the Headquarters stay back with the battery.

The tactical reconnaissance finished, he sends for them and proceeds to reconnoitre alone, and mounted, for his observing station and roughly the position of his guns.

The former is where he will observe dismounted unless it is absolutely certain that he will have to be on his ladder.

He then comes back, gives his B.S.M. directions as to his communications, etc., and goes dismounted to select his actual observing station.

He is followed by his director man with his director ready shipped to save time. The B.C. puts it up, lays it on the target or centre of the zone and calls up the Subaltern, who equally comes up, dismounted, looks over it and is then sent off to lay out the lines for the battery. As soon as he is gone, the range finder arrives and is given his orders. The B.C's man turns the director through an angle of 120° towards the battery and has a flag or picket put up to mark this line. This will be found to be a great assistance to the Subaltern who will know that his guns must not be behind this line or his B.C. will be in the danger angle.

As soon as the Subaltern has planted his posts in line with the target, he comes back and should find his director ready for him layed on the posts. If the B.C. has not selected the exact position for the guns the Subaltern will have to decide where to put them, keeping in view his orders as to cover. He tells his horse-holder where to go mark the line for the guns, and then picks up and measures the angle to the aiming point. Unfortunately last year, I think, we laid too much stress on its being in prolongation of the line of guns, and officers went for this in preference to very good ones at an angle. With the simple rule of dividing the angle which the line Director—Aiming Point makes with the line of guns, parallelism is very easily corrected, but it is extraordinary how often it was forgotten. Now let the Nos. 1 gallop out the last 100 yards and be halted by the Subaltern. They will halt their guns on the line and bring them into action. The Section Commanders now run to the director, look at the A.P. and back to their guns, and turn the finder of the dial sight on to the aiming point. Verbal descriptions are absolutely useless. Some B.C's, instead of their putting out aiming posts, like to send an angle to the Subaltern's director, and I am afraid I like that way best myself personally, but there is, of course, the possibility of error, and the aiming post way is a certainty.

The former will have to be done if the guns are behind any-thing like a wood, and everyone ought to be able to do it quickly and accurately. This is a very long story which can be done on the field far quicker that the time I have taken to tell it, and I only bring out the fact that it is a drill pure and simple.

We tried to find out how a Section Commander was to know when he had got 13 foot cover, and we found that if he went to where he could just see the target or feature from which he wants full cover, that he should drop his handkerchief or any article that he will be able to see, ride down the hill, dismount, and with the hand angle or sight instrument set at zero, move up or down till, with the instrument directed on the article he has dropped, the bubble is in the centre of its run, and at that spot he has 13 foot. This again sounds a long story, but when tactical considerations require absolute concealment the time taken to carry out this operation will not be wasted. Very, very seldom did Field and Horse Batteries really get 13 foot of cover, at least on Salisbury Plain. We carried out a practical trial to find if 13 foot was right, and found it was so.

Open Positions.

The Battery Commander goes on with his director man and trumpeter in close attendance, followed at a reasonable distance by the Subaltern with his staff, behind comes the B.S.M. with his party, the remainder of the Headquarters. The method I am now suggest-ing was tried this year and was found successful, and I hope will be put in *Field Artillery Training.* It is really what was done some years ago. The B.C. dismounts, as does his director man, and the director is set up (on the low legs if necessary) on the target or on the centre of the zone or on the reference point if he thinks it preferable; he calls up the Subaltern and tells him how the battery is to occupy the position, and gives him any other necessary instructions. The Subaltern gallops back to pass on his information to the battery or stays to help the B.C. The B.C. says to his director man "tell the officers when they come up that the director is on the centre of the target and that it extends 5 degrees," or "that the director is on the reference point. The target is 5 degrees to the right and extends 4 degrees." "Tell me the angle of sight directly you have taken it." The B.C. goes to his station and waits, and as soon as the guns arrive he takes hold of the traversing lever of the nearest gun, or the Subaltern does for him, and throws it on to the line. The Section Commander of that section, looking over his shoulder does the same to the other gun. The other Section Commanders having looked over the director do ditto with their guns. The only orders the B.C. gives are: "Angle of sight—Left ranging—Corrector 160, 34, 31," or as the case may be.

Every layer picks up an auxiliary aiming point to carry on with.

By this means I have seen a battery start in 18 seconds, and the average is 28 seconds from the time the B.C. halts the battery.

We claim that by this method every gun is put on the right line at once, fewer orders are required, and great quickness is obtained. One B.C. wrote to me and said—"the Horse Artillery had quickness of opening fire on the brain." My answer is that it is a very good form of madness so long as accuracy goes with it.

The Section Commanders, too, see the B.C's ranging rounds and know their line even if they were in any doubt before. Reference points described verbally are almost useless in my opinion.

The wagon limber of the gun nearest the B.C. should now be sent to a position for him to use, well behind the line, so that his voice goes down.

Semi-covered Positions.

When we come to occupying semi-covered positions it entirely depends on the amount of cover required. It may be any degree of cover between 13 foot and 0. Whether guns are to be run up by hand or whether the teams should come up and get away as quickly as they can, must depend on circumstances. Unless the ground has been carefully registered by the enemy I believe the latter can be done every time.

In a semi-covered position the battery is bound to be given away as soon as fire is opened. I think the only time when they will be run up by hand is when a position in observation is desired and it is necessary to conceal the operation, and there is time before fire is likely to be wanted.

If the target or reference point is visible to the Section Commanders standing up, the procedure is identical with the open method.

If it is wished to get concealment when occupying the position although the flashes when the guns have opened fire will be visible the best method undoubtedly is to drive along the position in column of sub-sections, action right or left, unlimber the wagon bodies and run them up by hand. Several batteries did this with the wagons on the enemy's side and the obvious happened, the wagon on any-thing like a slope got out of hand and ran downhill.

To get on the target from such a position, the B.C's director or the Subaltern's director should be left pointing on the aiming point and the angle previously measured, as in a covered position.

Before we leave the question of Occupation of Positions, there are one or two details in which B.C's are not agreed.

Some will not allow the layer to pick up an auxiliary aiming point for himself. I think it is a very bad compliment to the B.C's teaching, and to the man's intelligence.

The B.C's of all the batteries I saw on the Plain, and some of them had had the No. 7 Dial Sights only a few days, did trust their layers and successfully. It is tying one hand behind your back not to do so I think, wasting time and bothering the layer.

Some will not allow a Subaltern to put out the lines or select the position for the guns. Again I think it is a very bad compliment to the B.C's teaching and to the intelligence of the Officer.

Another point, and a very important one, is the concealment of the observing station. Bullets would correct it in war, but it is bad teaching to unnecessarily risk the lives of the brains of the battery, without which the carefully concealed guns are not of much value.

Use of Observation Ladder.

The ladder when it is provided must stay with the battery till the technical reconnaissance commences, it must then stay with the headquarters under charge of the B.S.M., and will be placed by him, and it must not be used unless necessary.

The 120° line will be a great help as to the placing of the ladder, as it must be either on or behind this line. It is quite possible that in war, risk or no risk, they will have to be used on account of space, but they are always going to be deathtraps. I can't help thinking cunning B.C's will put their ladder where they are not, and will observe from elsewhere.

I have talked a great deal about this occupation of positions, but it is like the "House that Jack built," one fault will bring out other faults and so on. The points in occupying a position are, that it must be done quickly, with the least possible information to the enemy, and the lines should be as nearly as possible right to start with.

I would recommend every B.C. to make the roughest model with earth or sand, shape it into hills, different positions, and practice indoors, with his headquarters, the occupation of positions. This applies to Territorial Artillery principally, but in places like Woolwich or Sheffield, or such like, where drill grounds are practically non-existent, I think much could be done.

When batteries go out to drill wash out the aiming points used on the last day, and make the Subaltern select others, and practice him in working out parallelism and so on, otherwise when he goes to camp he doesn't see his old friend, and perhaps gets into difficulties.

Difference of level of wheels. An instrument is coming, I hope, for the difference of level of wheels. The Nos. 1 will learn to work it very soon, and one source of trouble will disappear. Parallelism in the batteries that I saw had improved considerably.

Ranging. Now let us come to the ranging, and, pace the B.C's, there is a good deal to be said as to improvement required.

Gambling is very prevalent and some are perfectly happy to go to method of fire when they are not certain in their own minds that they have got the range. The old fault of gambling on high air bursts is still with us. "Thinks" don't count at Ranging. One B.C., a very good one too, said he thought there was too much deliberate ranging, and he liked jumping the range. The answer is that unless the range is found the results of shrapnel fire are absolutely nil.

We have now had two years of Collective, and it's the old story—some like it and some don't. The conclusion come to at several camps was that the best method of ranging on a gun target, or a crest line target, is to start with section ranging to get a 300-yd. bracket and go to collective—inside this bracket. It is when one is getting near that the doubts of + or - occur, but with collective these doubts disappear. The rounds verify each other and the first two lines are corrected during the section portion. This method is economical, easy, and I think is the right method, and I hope it will be adopted. I understand the disliked word "normal" is now defunct.

When everything is going right, ranging is easy; it is when difficulties come along that failures take place. And now to get out of difficulties—you have started with a Section and both rounds are lost. Shorten the Corrector and get smoke—you lose one round—repeat each end firing both guns with the same elevation. Certain B.C's are wedded to percussion, and in consequence frequently come to grief. One battery I saw this year who were very quick at starting, were nothing like quick enough at getting to effective fire owing to the B.C's prejudice against T.S. Ranging. Another conclusion generally come to was that it is better to give out the longer elevation first always, so as to simplify procedure. It is laid down now, to be done when supporting an infantry attack, and is apt to be forgotten if it is only done on particular occasions. Many were the corrector troubles, as B.C's will not be bold enough with their alterations. I go so far as to say that when all your shells are bursting on the ground come back 20 at least, and bracket your corrector this way, like your range.

Angle of sight troubles always will be with us, and we found that when odd things were happening it was better to say "Angle of sight is...."—the man who was wrong immediately put his sight correct, the delay was negligible, and the guns immediately shot right.

Miniature ranges have done much to help B.C's to give out their orders quickly and their deductions. Unfortunately the miniature range cannot reproduce real smoke, the observation of which depends so much on the wind and makes observation so difficult, particularly when it is blowing directly from or towards the battery. The smoke of a shell that has really burst beyond is quickly blown towards us and is visible in front of the target. There is no remedy for this but practice.

Howitzers. Time shrapnel ranging was tried with 4.5" howitzers, and was I think successful. Howitzers generally had quickened up a good deal. Various little mechanical helps were an assistance, and Captain Dreyer's system of ranging in yards with a false range for others than the 4th charge, is a move in the right direction. Only one man can make a mistake with this system, that one the B.C., and if he has selected the wrong range—what matters, he can always alter it. The tendency of Howitzer B.C's is to put their batteries too far back and so oblige themselves to go a long way away and complicate their communications. It is no use getting into position quickly if you are going to be slow afterwards, because as soon as you open fire the chances are you will draw fire, and the sooner you are top dog the better. This applies to all guns equally. We have improved our times for opening fire, and we must now learn to get to effective fire quickly.

1. A gun target in the open. Begin with section ranging with long corrector, and having got a 300-yard bracket go to what you believe to be the nearest hundred with collective. Remember the real range of a target is + and - with the same range. When the range is obtained go to Battery Fire, search backwards and forwards through the 100 yard bracket. At a gun target on a crest line this way is the only possible one. You won't find the range in a week with percussion. The reason for recommending the searching is that you can scarcely expect any battery target to be absolutely at right angles to the line of fire, although the obliquity is nothing like what it is with a long target. If you come to think of it even with the target at 45° one end would be only 50 yards further than the other end.
2. Flash Batteries. Get an obvious short and an obvious over. Give deflection to the flank gun to bring it opposite the enemy's observation station if you can see it. Go to Battery Fire to get the other lines right. Now go on adding and dropping at Battery Fire. Remainder add 50, and so on. Search till you lose the smoke of your shell, and come back till you see it again, on the principle of the rake.
3. Irregular Targets. Trench lines will always be irregular. Get a 100-yard bracket with section ranging with long corrector. Now go to slow Battery Fire and add or drop or alter each round as required. Quicken up the fire as necessary. Bursts of fire of Battery Fire 4 seconds is a very good class of fire, and absolutely under control. When our own Infantry is within, say 300 to 500 yds., drop to percussion, and when the charge is taking place lengthen the ranges and search. When adding and dropping, the No. 2 with 18-pr. and 13-pr. and the layer with the 15-pr. should call out the range on his gun loud enough for the No. 1 and fuze-setter numbers to hear what the range is on that particular gun. You cannot make range and line corrections for individual guns at Quick Battery Fire.
4. Registering. Methods for carrying it out were suggested last year and seemed to work all right. When Registering will be employed is another question, but it will certainly, I think, be used by batteries told off to look out for counter-attacks, and by batteries in the defence who wish to register the ground over which an enemy will advance. It was done frequently in the late Balkan campaign.
5. Advancing and Retiring Infantry. This takes us into the advancing infantry question. Remember that the enemy once com-mitted to a certain line must

keep to that line. He cannot edge off right or left owing to other troops being on his right and left. The method suggested and extensively tried was to register one spot, fire a round of Battery Fire to get the lines in hand, and then place the fire in front of the enemy when he appears. If he is advancing over a long open space it is probably better to keep it in front of the leading bodies. If he only shows at intervals it is necessary to predict the spots and place the fire for him to run into it. It is open to argument as to whether the guns are to be opened out over the whole space or kept parallel. In the latter case it is much easier for the B.C. to handle the fire. I cannot believe, although it is only a matter of opinion, when bursts of fire are necessary, that section control is going to be resorted to as the fire will be controlled by one hand. When the enemy come within, say 1,200 yards of our own infantry, he will begin to occupy fire positions and lie down and shoot. Then his position must be engaged exactly like a trench line. He will have come in to a much nearer range to us and observation will be easier.

6. Other moving Targets. Although these will probably occur very rarely in war time, still if a B.C. can take them on, he can take on anything. They require rapid thinking, and a battery to answer the helm exactly. It means prediction, alterations of range and angle of sight, and the battery putting its fire where the B.C. wishes.

   The position of Field Artillery wagons at present is seriously in the way if an enemy is moving to a flank, and I hope that before long Field Artillery will be allowed to unlimber their wagons as the Horse Artillery do now. Keep in front is the golden rule. The targets at a Practice Camp come very quickly, and owing to wire, horses, etc. it is never possible to give them a very long run.

7. Shock Action Targets. The Horse Artillery had reached a very high standard when engaging these targets. All preparations were made in the position of readiness. Once this year I saw a battery start in 11_ seconds from the time the order was given to halt, and 35 rounds, most of which were judged effective, were fired before the target had finished half its run.
8. Natural Targets. Woods at long ranges. The overs are generally lost, range with a section, get an obvious short and creep up to the edge. That is the place from where hostile fire will be issuing.

At short ranges—do not attempt to range with percussion. I have seen disastrous results this year from so doing. At very short ranges the trajectory is so flat that I think the percussion strike the smallest obstruction and go on to burst beyond, and are most confusing. Range with effective length of corrector and crawl up.

I think I have discussed now all the different patterns of targets and given the views that we have all come to after seeing many batteries try the same things.

Responsibility for correcting for line.

One point that came out very often was as to who should correct for line when the Section Commanders can see the target. The book says the Section Commanders are to correct when they can see, and there are often too many cooks, the B.C. and the Section Commanders both doing it. I think, and I hope, it will become law that the B.C. should always correct unless he gives the order "Section Commanders correct for line." We know that they can correct when open sights or telescope are being used, but when indirect laying is used they can correct only at a standing target or at a moving one that is coming directly towards, or going directly away from, the battery.

Bar Indicator.

Another small point is the difficulty found of ranging for fuze when below 1,600 yards. Several Horse Artillery batteries had Range and Fuze slips printed in large figures, and pasted on the lid of the wagon. This took it off the shoulders of the B.C. and worked very well. The question has been gone into very carefully and there is no good mechanical solution without attaching another piece to the bar indicator.

Howitzers.

There is no necessity to say anything in particular about the howitzers beyond what I have said already. I am personally a great believer in the 4.5" howitzer, so much so that I would like to see a battery of howitzers in every Field Artillery Brigade. They were tried in Ireland at very short ranges supporting the attack, and I understand very successfully. Whether this is going to be possible or advisable is a matter of opinion, as these batteries carry very few shell. It is a very nice point as to whether they will ever get any more ammunition, if they approach too near to the enemy's position. They were allowed to carry lyddite fuzed, which was a great saving in time and trouble.

Method of fire.

A point I should have touched on before is the method of fire to be used. Most of us came to the conclusion that one round of battery fire is unnecessary for guns that can be unloaded. Battery fire at any interval seemed the most suitable. Gun fire is only of use at a Shock Action Target, and section fire, in my opinion, is an uncontrolled fire. There are, however, differences of opinion on the subject, and it is argued that when a slow rate of fire is to be kept up that section fire is best, as the battery fire would come much too slowly. At moving targets I saw battery fire kept up by a 4-gun battery at four seconds interval with excellent results.

Heavy Artillery.

I saw the 60-prs. do elementary on Salisbury-Plain and I was much struck with the drill and accuracy, but I do not like the Observing Officer doing the B.C's work at the latter's station. He was never meant for that. He was meant as an auxiliary when a separate observing party goes on. On one occasion there was a party of 3 officers at the observing station, and no commissioned officer with the guns at all. The Heavies, like the Field Artillery, are rejoicing in the possession of the No. 7 Dial Sight.

No. 7 Dial Sights

Only three 18-pr. and one 13-pr. batteries practised at Lark Hill with No. 7 Dial Sight. They were of course obliged to use aiming posts. With one Division of Territorial Artillery we tried doing without them with much success, but of course the 15-pr. is a very steady gun. When aiming posts are put out with this gun, chaos is apt to ensue as soon as the deflection on the deflection bar is used up.

Sweeping

In my opinion sweeping should be carried out at battery fire as well as section and gun fire. The gun would be re-layed for line and elevation after every round. Remember this little rule to know how much sweep is required:—"With a 6-gun battery multiply the number of degrees the target subtends by 3, 5 for a 4-gun battery, 9 for a section."—This gives the sweep in minutes.

Checking Sights and Range Dials.

The simple method recommended was successful. It simply consisted in bringing the line of the rocking bar sight to the horizontal by using a straight-edge and field clinometer on the fore-sight and back-sight of the rocking bar sight, making the sight clinometer agree, and then bringing the muzzle to the horizontal and making the range dial agree. The muzzle was brought to the horizontal by putting the field clinometer on the guides near the muzzle, and moving the wheel on the right side till the bubble is in the middle. This competes with the droop and does away with any bother consequent on the planes having been altered. Great ingenuity was shown when casualties were made to instruments—on one occasion directors, flags, and aiming posts were taken away and the Subaltern Officer concerned was full of resource and success-fully competed with the task.

Capt. Hill's Lecture.

I must allude for a minute to Captain Hill's lecture last year which attracted a great deal of attention. He said that guns required grouping. The C.R.A. 2nd Division kindly tried it, and Captain Hill has now recanted it in an article sent to the "Journal of the Institution." Check the Sights and Range Dials and the guns shoot alike.

His other remarks, though, about bursting shells too short much were taken to heart—so much so, that at some camps grazes were really too numerous. His other great point, asking for extra accuracy in ranging, is always to be borne in mind. Remember it is a curious fact in Natural History that whenever we see a round burst over we immediately pull the range back, but we see any number burst short without putting the range up, and yet the real range is + and - with the same ranges.

The only other point to bring out in this year's work was the employment of a forward Observing Officer, much advocated by the G.O.C. R.A. 1st Division. Undoubtedly he will be used occasionally but I think purely as an officer for observing effective fire with no tactical powers, and I do not think he will be sent out without the special permission of the C.R.A., and then with a view to observing some particular target that cannot be observed from the battery end.

Line of fire by Compass.

It is recommended from one camp that Battery Commanders should learn to get the fire of their batteries on to a target by means of a compass, and I certainly think everybody should know how do it. In an enclosed country it will probably be the only possible way. 4.5" Howitzer batteries have two No. 3 Directors and can do it, but at present we have no compass on the No. 1 Director. Maps must be more studied for ranges.

The one-man Range Finders are very good, but the map and the gun, particularly the latter, are better.

Retirements.

There has been a good deal of misunderstanding about the retirements this year. Every care must be taken on the conditions then existent. I personally don't think there should be any words of command or any stereotyped method. I think you will send the Captain and tell him to let the Section Commanders know what is going to happen. The withdrawal might be by a gun at a time or by six guns at a time. If the Captain and Section Command know what is going to happen, and the Captain gives the proper orders, there should be no confusion.

Aeroplanes.

We made a great deal of progress this year—with the gallant officers of the R.F.C. observing our fire and locating hidden targets. I need not enlarge on the details, but the best day we were put on to a hidden target in seven minutes with seven rounds. An average time, but it depended a great deal on weather, was about twenty minutes. Of course some observers were more proficient than others, and some pilots, more daring than others, shortened the operation considerably. The system employed is about to be embodied in the new F.A.T.

During the Divisional Field Firing of the 3rd Division, an aeroplane observed the fire of one battery on to a hidden target close to other targets which were being engaged at the same time. The battery ranged a salvo of three rounds, and the airman had no difficulty in observing the fire and reporting the results.

Instruments.

Directors. Are the Directors well enough known? There should be, besides the Officers, at least three or four N.C.O's who can work the director. It did not seem to me that they are so well known as they should be. The days are gone when a B.C. was frightened of his director. In the early days of directors, one well known Officer threatened to put his B.S.M. under arrest if he brought it near him. The director is a good friend and should be treated as such.

Before concluding, I should like to say a word for the good work I saw done this year at Practice Camp by certain Territorial Units. The training and turn out of some of them had reached an extremely high standard considering the time at their disposal, and was most creditable to the Officers, N.C.O's and Men. I have finished all I have to say, or rather all one can say in an hour's lecture. Last year, after I had finished, one of the audience told a friend of mine that he hadn't agreed with anything he had heard, and that it was "rotten." This may be the same this year, but I am afraid if so that it is the best I can do.

Discussion.

MAJOR H.T. BELCHER, D.S.O.: The Lecturer mentioned that certain batteries seem to have quickness on the brain, and, as an onlooker at practice camps for the last few years, I could not help being struck by the great difference there is in the standard of drill reached by various batteries, more especially in the standard reached by the staffs of batteries. It appears to me that, as far as drill is concerned, greater perfection might be obtained without the firing of a single round, thus enabling batteries to take full advantage of their instruction in more advanced gunnery and fire tactics. Would it not be possible to examine all batteries and insist on the attain-ment of a certain standard of drill before allowing them to practice? My suggestion is that a day should be allotted, at the beginning of camp, to testing the drill of gun detachments and staffs, and that this test should be carried out on the practice ground and with ordinary practice targets. It would not be difficult I think to devise a series of standard tests in which marks would be allotted for both time and accuracy.

Another point I should like to speak about which the Lecturer referred to is this proportionate corrector. It would be rather interesting to hear the views of different officers on this point. My view rather is that we made a very great mistake in adopting proportionate corrector, and I think it is a mistake which has hindered progress almost as much as the retention of the 6-gun battery (Laughter). It seems to me that we strain at a gnat in insisting on proportionate correction and at the same time we swallow two enormous camels—one, that the alteration of the corrector bears no fixed relation to the corresponding alteration in the height of burst,that is to say we have got to think whether you should alter your corrector by 2, 6, 12, or perhaps 20, according to the range, and the other is the fact that the adoption of this proportionate corrector seems to have completely barred the way to a fuze-setting machine. I rather hope that the powers that be will experiment with a fuze indicator, at any rate, in which the correction will correspond to alteration in height of burst; that is to say, if you want to alter your height of burst by 20 minutes you will have to alter the corrector by 20. (Applause).

MAJOR H. ROWAN-ROBINSON: I was privileged to attend Practice Camp this year and, looking at things from an outside point of view as a Garrison Artilleryman, perhaps my remarks may be of some value. Being new to the subject I studied *Field Artillery Training* carefully and took a barometer down with me in order to work out the corrector daily. On the first day, according to the barometer and the figures in the book, the corrector ought to have been 146; it was found by the guns to be 158. During the rest of the week I was there, leaving out cases where a false angle of sight was found, the figures remained roughly the same. I tried to find out the cause of the difference, but without success. It was not the round, it was not the temperature, but I thought it might have been due to a considerable variation of muzzle velocity from the normal. Unfortunately I could not discover the muzzle velocity of the particular lot of cordite that was being used. The batteries going into action knew from previous shooting that the corrector ought to be about 158, and, when it worked out at that, naturally did not worry over the fact that from the book it should have been 146. Batteries in war, however, not shooting always from the same practice ground depend for the estimation of their initial corrector, on the figures in the book. It would seem therefore advisable, when book and shooting vary, to study the cause of the variations and then to give some guidance on the subject in the Manual.

When studying the subject personally, I found that, according to experiments carried out with No. 80 fuzes, the multiplying factor should be, not 1/44, as stated in the book, but somewhere about 1/25. It may not seem a very important point, but a Battery Commander coming into action in South Africa at a height of 4,000 feet and a range of 4,000 yards would, following book figures, find a corrector that would cause his fuze to burn 200 yards too long. The Lecturer said that people were very apt to creep with their corrector. That being so, in the example quoted, a B.C. might waste a good many rounds before he found the true corrector. Moreover, finding the latter to differ considerably from the book figure, he would lose confidence in his Training Manual. I would therefore suggest the alteration of the size of the multiplying factor in the new *F.A. Training.*

The next point that struck me was that no notice was taken of corrections required for changes of temperature and pressure. On page 149, I think, of *F.A.T.*, it is stated indeed, that variations in temperature and pressure, variations of heat of cordite, etc. will cause variations in range, but no guidance is given as to the direction or amount of the variation. These things can be worked out, and I think should be worked out. The arguments against the application of an initial correction are that it tends to make Battery Commanders slow and that, to work it out, a barometer and thermometer have to be carried with the battery. (Laughter). An aneroid barometer can be carried in a waistcoat pocket and a thermometer on a watch chain, so that you are not burdening your battery very much. If we study the conditions of recent warfare, it will be seen that the suggestion of an initial correction is not outside practical politics. Taking a range of 4,000 yards as a standard the corrections to apply would have been: at the action at Guru in Thibet, shorten 600 yards; in the South African war, on an average, shorten 300 yards; in the Libyan war, shorten 200 yards; before Chatalja, lengthen 150 yards; in the Manchurian war, from the summer fighting in the mountains to the winter fighting in the plains, the correction would have altered from shorten 400 yards to lengthen 200 yards—a total variation of 600 yards, which seems worth considering.

I submit that some guidance should be given in the Training Manual to assist people in making corrections for abnormal conditions, for it does seem a pity when you have a good gun, such as ours has been proved to be, and a good range-finder, and when you have trained your layers to lay and your range-takers to measure the range correctly, that you should sacrifice all and be 400 or 500 yards out, simply for the want of a little working out of the matter beforehand. (Loud applause)

BRIG.-GENERAL N. D. FINDLAY, C.B.: The Lecturer referred to the Forward Observing Officer, and he asked me to say a few words with regard to his employment. We have made considerable use of such an officer during the past training season in the artillery of the 1st Division, both at practice camp and during manoeuvres, and I think that most of the officers who have seen the system tried have agreed as to the benefit which may be derived from it.

As to the system itself, it is no invention of mine. It was adapted by Colonel W. T. Furse (at that time one of my Brigade Commanders, and now General Staff Officer at Cork), from a similar system in use in Germany, and described in the Field Artillery Training Manual of that country. Colonel Furse arranged for the provision of the stores required, namely some special telephone instruments and wire, the latter on reels with fittings which enabled them to be easily carried and the wire to be freely run out and reeled up.

The observation party consists of an officer and two non-commissioned officers carrying the reels and instruments. They are sent forward by their Brigade Commander, their duties being first to report on the accuracy of the fire, next to report on the movements of their own infantry, and to make sure that the latter are not coming under the fire of the batteries, and finally to report on any of the enemy's forces, such as batteries, infantry entrenched, or machine guns which are inflicting loss on our infantry, and which cannot be located from the battery observing stations. Of these duties the first (i.e. reporting on the accuracy of fire) can be carried out at practice camp, as can the third, the new targets of course being arranged for by the camp staff beforehand. The second duty as far as reporting on the movements of their own infantry is concerned can be carried out at field operations. The party does not necessarily accompany any particular portion of the advancing infantry, but moves, keeping under cover, from one point of vantage to another. Its object is to see what is going on, so that it can send back the required information by means of its telephone, or failing that, by signalling, semaphore for choice. I cannot agree with Colonel Bingham that the use of forward observing officers should only be tried occasionally. What we as gunners want to do is to ensure the accuracy of our fire, and this becomes more and more important the closer the opposing infantries draw to each other. We want to avoid hitting our own infantry and at the same time be able to take on any portions of the enemy's force which check its advance, and to do these two things we must know what is going on at the other end. In this, however, we are apt to fail, especially when Battery Commanders are observing their fire from positions close to their batteries. The forward observing officer is employed in order to minimize the chances of such failure. I think, therefore, that the system should be practised by us as much as ever we can, because we shall then be able to make up our minds as to whether it is of any use, and also because if it is to be used in war we must practise it in peace. Personally I think it will be of great service in war. At Okehampton this year it was carried out on many occasions, and reports were sent back which enabled the fire to be corrected. On other occasions the positions of new targets were indicated which could not be seen from the neighbourhood of batteries, and it was found possible to turn the fire on to them and send such information regarding the fall of the ranging shell as enabled effective fire to be brought to bear on them. At Okehampton there are certainly considerable facilities for trying a system of this nature, because the observing party can get behind rocks and obtain cover in a way they cannot do on flat ranges. One necessary adjunct is a switch board. If the Brigade Commander has one he can connect up the forward observing officer with any battery the fire of which that officer is required to report on, and the result of the observations can go to the Battery Commander direct.

This is a general description of what was actually done in the way of experimenting with a forward observing officer this year. I think it would be a great thing if officers took up the question, because we know perfectly well that the Regiment has only got to prove the necessity for any system or for any particular stores and it always gets them. (Loud applause)

GENERAL T. D'O. SNOW, C.B.: I should rather like to say a word about that which has been referred to as the Forward Observing Officer. When used to report back what is happening with regard to the bursting of shell, well and good; but I do not quite follow if it is intended that he should report back to the Brigade Commander about certain new targets cropping up and certain points which want more fire turned on to them, as, if so, I think he may be taking the whole thing out of the hands of the Divisional Commander and the Artillery Commander. If we could always have Artillery Officers up in the firing line and the reports came straight in to the Divisional Commander, or even to the Artillery Commander, we might get on, but I think it would be a very dangerous idea to have such information going back to the Brigade, because the Brigades will be doing things I am sure they ought not to be doing, and getting on to new targets they ought not to get on to. Nobody knows the situation so well as the Brigadier of the Infantry which is engaged, whereas you are getting right past him and getting to the Artillery Brigade Com-mander. Possibly I misunderstood you.

GENERAL FINDLAY: I am afraid I did not make it clear.

GENERAL SNOW: If you would not mind telling me afterwards. While I am up I would like to say that I had hoped the Lecturer would tell us something about targets, as I was not altogether satisfied with their employment this year on the Plain. Personally speaking, I think that if it is necessary always to have targets to denote infantry advancing, a great deal of tactical instruction must be sacrificed. The moment arrives in a tactical scheme when the Director says "Now the only thing which could happen would be that the enemy would counter-attack from that point." Unfortunately there are no targets to denote such a counter-attack, so he has to create a situation which is unreal. Furthermore, these targets are not a bit like what you will shoot at in war. It would be much easier for the Director to create interesting and more real situations if infantry targets were abolished and the infantry target was pointed out by saying "the enemy's infantry are advancing, at the present moment the right of his firing line rests on that gravel pit and the left on that ash tree." Such a procedure would, I think, be just as good or better instruction for the artillery, but I should like to know whether there is any objection to it. (Applause).

GENERAL FINDLAY: I am afraid I did not make my meaning quite clear. I did not wish to imply that the artillery were to play their own battle, and take on any targets they saw. It is laid down in the *Field Service Regulations* that it is the duty of Artillery Commanders to keep themselves informed as to the progress of their infantry, and in our Training Manual we have much the same sort of instructions about the establishment of an advanced observation line to watch the infantry situation generally, to obtain information from subordinate Infantry Commanders, and communicate their observations direct to Artillery Brigade Com-manders, but we have no information given us as to how this is to be done. I think it will generally be necessary to send out one Forward Observing Officer per Field Artillery Brigade, and the information received will come to the Brigade Commanders. They will act on it or report it to their immediate superiors with a view to obtaining instructions, exactly as in the case of any other informa-tion they receive. For instance they would act on it at once if it dealt with the accuracy of the fire, or if by doing so they did not depart from the task originally allotted to them, but they would ask for orders from their immediate superior, the C.R.A. of the Division, or an Infantry Brigadier, as the case might be, before turning the fire of any of their batteries from the objective engaged, in order to fire at another objective which happened to be outside the particular zone allotted to them. I had no wish to suggest that the artillery would in any way play their own game. That is the answer you wanted, Sir, I think?

GENERAL SNOW: Yes.

COLONEL E. A. FANSHAWE: These advanced patrols are always used in the 5th Division. They were originally started in Ireland ten years ago by Sir William Knox, but we have not perfected them so much as they have done in the 1st Division. The order for them was that they were merely to assist the eyes of the gunners, and they were never to be used for transmission of orders.

GENERAL FINDLAY: If you have got them there why not let them help with other things?

COLONEL FANSHAWE: Because the orders should not come from the front.

GENERAL FINDLAY: This is not an order. Have you ever known it officially to be acted upon unless the Commanding Officer wishes it?

COLONEL FANSHAWE : The orders were that they were merely to assist the eyes of the gunners.

COLONEL H. A. BETHELL: There are one or two remarks I should like to offer. In the first place, with regard to the training in tactical co-operation between Artillery and Infantry, the Lecturer tells us that in peace time we cannot shoot over our own Infantry, but that we cannot teach Artillery and Infantry to work together unless the Artillery shoots over the Infantry. Therefore it follows that you cannot in peace time train Artillery and Infantry to work together at all, but with that I disagree. I do not think it requires more than a moderate amount of engineering to devise dummies representing the Infantry which could be pulled up as the Infantry is supposed to advance, and these dummies could be placed under the control of an Infantry Officer. I have seen that method worked, and on a German range I have even seen puffs representing the fire of the Infantry—semi-smokeless puffs were let off on the range in front of the guns which hardly obscured the view. I think if our authorities in these matters took the question of co-operation between the two arms more seriously a great deal more could be done in that direction.

Next, as to the point or limit at which Artillery should cease to fire over Infantry when the Infantry are attacking and the Artillery is supporting, we all know it is desirable that the Artillery should fire up to the last moment. About three years ago the French and the Germans both laid it down that the Artillery must stop or divert their fire when the Infantry arrived within 300 metres of the target. Two years ago the Germans reduced this distance to 200 metres approximately, and at the same time the French laid down that the Artillery must continue to fire down to 150 metres, that is when the Infantry were within 150 metres of the target, then using percussion shrapnel instead of time. We chose at the same moment to go back again and to say that the safe distance at which Artillery might fire over Infantry is about 400 yards. I think we shall all be glad to hear that it is proposed to modify this ultra-safe Regulation.

COLONEL BINGHAM: It is.

COLONEL BETHELL: There are one or two other minor points. With regard to coming into action in the open, I tried the method suggested by the Lecturer of putting up the director beforehand, and getting the Section Commanders to come and look over it to get the line of the target, but I found the director acted as a sort of fly trap or magnet. It attracted everybody. My own Staff came and clustered round it, and more especially Staff Officers. (Loud laughter). If you stick up a director anywhere on Salisbury Plain, you are sure to have a Staff Officer with a trumpeter galloping up to it. I thought I would rather not have my position given away in this manner, because when I stood up I should probably be shot, so I took it lying down without any director. When the battery arrived I layed the centre section guns myself and the Subalterns of the flank sections took the target from them. That system I found worked fairly well. There is only one other small point. I agree with the Lecturer as to the confusion which arises when gun fire is tried, but there is one method which I agree with—rounds of battery fire. Let the Commanding Officer order one round of battery fire, five seconds, or two rounds, and then the men know there is something definite to do, and that they will not be hurried to begin again. With continuous fire from flank to flank a man can never be certain when the last gun has gone off, and he will be called upon to fire again, and the consequence is that the layers are always hurried. If you give it in definite batches, six shots at a time, the Commanding Officer can repeat these as often and as quickly as he pleases, and there is far less excitement, hurry and confusion. (Loud applause).

MAJOR J. H. W. JOHNSTONE: The Lecturer laid it clown that in a covered position the B.C. was not to select the position of the guns, but to remain and watch the tactical situation. As there is already a man trained to do this, and as he will have to do it when shooting commences, I suggest that he might do it from the beginning, and leave the B.C. free. The selection of the position of the battery is often by no means easy. It must not be a yard further away than necessary, and yet not in the danger angle; it must be completely under cover, and yet the trajectory must clear the crest. The forward officer is often an extremely young officer, and to leave all this to him, together with the marking of the line of fire, and selection of an aiming point is, I think, to put too great a responsibility upon him. At least it might be left an open question; the B.C. might be allowed to remain and watch the tactical situation, or he might, if he thought fit, go and select the position of the battery himself, but the responsibility should be his. Matters become especially complicated, Sir, when more than one battery is coming into action near one another. (Applause).

MAJOR W. ELLERSHAW: Could not that present column, which we see in the "Report on Practice," giving the number of effective rounds, be done away with, Sir? I take it that it has a very bad moral effect on the officer conducting the practice. (Laughter). It is the one column he always looks at first thing in the ante-room, and on that he either pats himself on the back, or feels depressed, forgetting entirely the General's criticisms, which would otherwise, perhaps, have gone home. It seems to me that effective rounds are rounds either which produce the desired effect in keeping the infantry's heads down, or rounds which hit; and I should say that percussion shell bursting close up to, or even beyond, the target are equally effective in keeping mens' heads down, if not more effective, than many registered as such. Also there are many series where there have been no effectives reported, and yet we see a large percentage of the target has been destroyed, or a certain amount anyway. If we must have that "effective" column could we not have a rectangle worked out which would include both pluses and minuses, giving us the best average effect? My own idea is that the object of the guns still is to hit, and the percentage of target destroyed (that is the hits) is a definite matter which could be counted, whereas, the "effective," which I object to, is left entirely to the discretion of the range officer, whose opinion might be questioned. (Applause).

COLONEL HUGHES: There is one question I should like to say a word upon, and that is the question of the tactical and fire training. I cannot help thinking that we do not do enough tactical fire training at the large centres such as Aldershot, Bulford, &c. For four out of my five year's command I was at Bulford or Kildare, and yet I was only once taken out by my C.R.A., and that was because

I specially asked him to do so. Of course more is done now than when I left, but even this year several Brigade Commanders have informed me that they have never been taken out for such instruction.

I am old enough to remember when we started shooting, and it was then laid down, rightly I consider, that shooting and a limited amount of fire tactics only, should be taught at practice camps, and the main fire tactics at training centres such as Aldershot, &c. It being recognised that these centres were the proper places for tactical instruction, and that such instruction, beyond a very limited amount, was impossible at practice, owing to limits of ammunition. range and safety.

Twenty years went on and the Regiment learned to shoot, and then the cry suddenly arose, "We know nothing of fire tactics." To me this appears a condemnation of our system of training, and the question arises, Why this failure? Without however seeking an answer to this question, the cry at once goes forth for fire tactics to be taught at practice camps, and in response, the whole training is crammed into the already too short practice.

I am sure that if practice camp accessories, such as puffs, blanks, dummies, &c. were available at other stations, a great deal of fire tactical instruction could be given to Brigades by their Divisional and Brigadier Generals. There would be no difficulties such as General Snow mentioned. The other arms could take part and there would be no limitations on schemes such as are unavoidable at practice. The Lecturer said you could do it on ordinary field days, but such was not my experience. They are too rapid and there is too much going on.

If, however, you have special field days, well thought out schemes and carefully made arrangements, a great deal of most useful tactical instruction can be given to Brigades and Batteries.

I used to have such schemes for my batteries, and I think the Battery Commander thought them useful, at all events they said they did.

I however always felt that at Brigade practice I was the weak link and that I should have been able to have done more justice to my batteries had I myself received some such instruction as I endeavoured to give them. (Loud applause).

THE CHAIRMAN: Perhaps Colonel Bingham would reply.

COLONEL BINGHAM: With regard to Major Belcher's remark re: preliminary drill inspections before proceeding to camp. I think you must leave everything of that sort in the hands of the Divisional Artillery Commanders. Entire latitude is left to them as to what their batteries should do, and if they don't think a battery is fit to go beyond a certain stage of practice they are at liberty so to order.

The old practice of examining a battery for laying, etc. the day of arrival in camp has, thank goodness, gone for ever. I have not got time to go into the question of proportionate and non-proportion-ate corrector; the matter is at present under consideration.

I am afraid I cannot agree at all with Major Rowan-Robinson's plea for greater accuracy. No one in the field is going to play about with barometers, thermometers, and pressures, and such like. He began by saying that at West Down they knew the corrector and were not disturbed because it was not theoretically what it ought to have been. As long as the guns were firing with the proper corrector I do not know what more was required. Field Gunnery is not an exact science like Coast Artillery, which fires from a fixed platform at a fixed height above sea-level, etc., etc. The range of the day with Field guns is the range found by the guns, and the gun is the best range-finder, better than all the scientific instruments in the world. The corrector is that found by the B.C., and, affected as it is by the angle of sight, it is not going to be a scientifically fixed point found by the use of instruments. I am sure Major Rowan-Robinson's figures are correct, but, as I commenced by saying, I cannot agree with him about the necessity for going deeper into the question than we do now.

General Snow's question re: targets is a very difficult one to answer. I know the targets do not represent Infantry advances or retirements. He was at West Down last year, where unfortunately they had no telephones to help work the targets, and everything had to be arranged beforehand as a set piece, worked by coloured screens and flags. Even with telephones it is difficult to make movement realistic, as there are limitations in representing living targets by wood, iron, canvas and wire, and danger considerations come in very considerably. I can speak with experience, having had a man and some horses killed while pulling a moving target, and I confess to having been very shy about them ever since. We have tried very hard to improve the targets, and I think ours were better this year, but I know they were not good enough.

With regard to having no targets at all, I think it would be a dangerous experiment to have none. Officers would lose interest in their shooting and would say, "I know just as well as the Range

Officers whether my fire was effective or not."

Colonel Bethell has a little misunderstood what I said. I did not mean to say that we could not or did not practise co-operation, but what I said was that so long as we cannot fire over the heads of our own Infantry not much can be learnt about co-operation. What is the kernel and gist of co-operation; it is firing over the heads of our own Infantry at the proper time up to the last possible moment. I am told that in India they do it, but I have never been able to get hold of anyone who has actually seen it done.

I don't think Colonel Bethell need be anxious about the visibility of the director. On service it will be studiously avoided if it is a danger spot, and on its low legs it will be really invisible. I should chance its being hit if it is a satisfactory method of pointing out targets quickly, which I think it is. I agree with Major Ellershaw about effectives. I have always been very sceptical about their nature, and that is why I say put dummies into every possible target and let hits be counted. The effective is most illusory, and on an irregular target the Range Officers remarks are not worth having.

Major Johnstone doesn't like anybody but the B.C. "putting out the lines" in a covered position, but I think it is a poor compliment to the B.C's teaching and to the intelligence of highly educated officers to say that they cannot be trusted to do it. I am afraid I don't know who the man is besides the B.C. who is going to watch the tactical situation, but it certainly is not the look-out man.

I agree absolutely with Colonel Hughes' remarks, and I know he did it himself with much success, but I think he would find that Divisional Commanders do do now what he suggests as far as the general run of the Artillery stations will allow.

I think I have answered in as few words as I can the questions that have been asked during the discussion. (Loud applause).

THE CHAIRMAN: I think we have had a most interesting lecture and I think we may claim to have had an exhaustive and illuminating discussion.

I would like to emphasize, if possible, my own personal opinion that we ought not to dismiss from our minds the question of the Forward Observing Officer. Let us study him during the coming season. If you look at page 243 of the "Army Review" of July of this year, you will see that he is much used by the Germans, and for both purposes. I think that is a point we want a good deal of light upon and to which our attention might be directed next year.

Colonel Bingham has dealt with most of the other points that have arisen in the discussion. As to the difficulty of targets, I think it is a good deal reduced at some of the camps favoured with a good telephone service. Colonel Bingham referred mainly to moving targets. I think we might do much to improve the siting of our fixed targets by obtaining the assistance of the General Staff Officer of the Division, or someone of that nature, to help in putting them down. Further, careful drafting of the scheme should prevent unreal situations such as General Snow has hinted at.

Now I want to say a word or two about tactical practice, which has come in for a good deal of criticism, mainly as a waste of ammunition. It is contended that our ammunition would be better expended if wholly devoted to gunnery practice. With that I disagree. It must be borne in mind that practice is part of our training, and training is preparation for war. What does war require of us in carrying out our mission of co-operation with the other arms? To hit is the reply, and certainly it is to hit, but not only to hit—something more—to hit in the right place, and at the right time. We may be perfect shots, but unless we understand how to apply our fire with accuracy at the right place, and at the right moment, we shall not help materially to win the battle. We study tactics, and we pay great attention to the principles and problems that arise in connection with artillery support, but all that study and consideration will avail us nothing unless we practice the application of our fire in accordance with those principles, and verify the solution of the problems by the bursting of our shells. Besides, the whole system of our practice is progressive—elementary, gunnery, tactical; drill, shooting, application of fire; and the whole of them bound together (this is my point) with one common bond, and that is accuracy. Do not let it be imagined that tactical practice shall cover a multitude of inaccuracies; I think that is an entirely wrong conception. Where there has been disregard of accuracy the officer directing the practice must be held responsible cither for having drawn a bad scheme, or for having allowed it to be carried out in an uninstructive manner.

There is another point regarding which I wish to say one word, and that is collective ranging. I claim that we owe a great deal to collective ranging. Collective ranging has taught us one thing, and that is the use of time shrapnel ranging. In the summer of 1911, we used only one method of ranging—percussion shell. Time shrapnel was very seldom used. We hammered away with percussion shell at every target, suitable or unsuitable, and the result was that we used to take a very long time in arriving at effective fire. Then Officers, of whom Colonel Bingham was one, went abroad to visit Practice Camps in France, and came back to this Country and told us one or two not altogether palatable truths about our own pro-ceedings. The remedy lay in the direction of time shrapnel ranging and our experience in connection with the collective system has taught us how to use it, and we have further found out that no special method will apply to every target, but that we must vary our methods to suit our targets, using that particular one which appears to be most likely to attain our object.

Another word. Now that we have got excellent Manuals in the *Field Service Regulations* and in *Field Artillery Training,* let us try to stamp out the light regard some of us appear to hold for Regula-tions. We go aside from the Regulations in our dress, in our turn-out and in that of our batteries, and we have gone aside to an unlimited extent in our practice. Any one of us who has had a special fancy has let it have full vent on the practice ground. We have been wrong there, and I would like to say now, "Let us adhere to the Regulations; let us work on a uniform system, so that anyone can step in at any moment and command another man's battery." (Loud applause).

I think those are all the points I wish to refer to. There remains to me one duty, and that is to recall to mind that we are losing Colonel Bingham as our Chief Instructor, and that the loss is very great. I can testify from my own personal experience that during the last two years, Colonel Bingham, as Chief Instructor of Horse and Field at the School of Gunnery has done extraordinary good work. (Hear, hear, and loud and continued applause). He happens to possess many points particularly fitting him for that position. He has deep professional knowledge, and the power of imparting it to others. He has keenness, energy and enthusiasm, and a personality which carries him through everything. (Loud applause). I shall be expressing your view as well as my own when I say that although we congratulate Colonel Bingham on his well merited promotion, still we cannot help deploring our own loss.

You know the proverb about the tempering of the wind, and we have been able to secure a successor to Colonel Bingham, who, I am sure, is extremely well fitted for the post. (Loud applause). I happen to know that Colonel Uniacke has already set to work with a will.

Gentlemen, there only now remains for me to ask you to join with me in expressing to Colonel Bingham our appreciation of the trouble he has taken in preparing this lecture, and his kindness in coming here to-night to deliver it.

4: GHQ Notes on Artillery in the Present War

Source: G. Helps Papers, IWM

Positions occupied.—With a few exceptions positions are completely covered and, not only from view at the target end, but from possible air observation. The enemy possess large scale maps believed to be as large as 6-inch, and, as soon as guns are located by them, a severe fire is brought to bear immediately. It is on this account important to avoid always conspicuous or easily-identified points on the map. Ranging, as we understand it, is as often as not dispensed with altogether. Open and semi-covered positions possess no advantage over covered positions. They would only be occupied on emergency and with the knowledge that the battery would probably be destroyed sooner or later.

Positions of readiness are only to be considered if well concealed, but guns not required in action are better placed safe out of range.

Observing stations.—In the open position the choice appears to make little difference. If, however, occupied in the dark and the battery completely dug in, the battery commander is better on a flank clear of blast and smoke of enemy's high explosive shell. In covered positions the battery commander almost invariably observes from in front no matter what nature of gun. The distance, from 500 yards up to 1,000 and more, according to nature of operation and ground. Communication always by telephone. This, indeed, is the only possible means and endeavour is made to dig in the wire, perhaps with a plough.

In the event of wire being broken, recourse must be had to chain of orderlies. Megaphones are useful.

Obtaining the Line.—Two aiming posts seem to have been sometimes, but seldom, used. A battery angle is sent if battery commander can see the battery; but far more often line is given roughly in a quick series or by compass or map in a deliberate series. Trial shots are fired and correction made as required. With heavy guns the method employed is either the compass or direction given by a reference to a map placed on a plane table, the latter the most popular. Where possible, as in the operations on the Aisne, the 18-pr. gun may be used to range for the 60-pr. to save ammunition. There are many casualties to directors. The hand angle of sight is a good deal used. Plotter never used and may be dispensed with.

Battery headquarters is too large. Signallers and lookout men are not wanted as a rule. Patrols and ground-scouts never—i.e., as part of the battery headquarters. The battery commander has battery serjeant-major and a telephonist with him, and perhaps a director man who will take a few notes as penciller. The range-finder would be separately dug in, if used at all, and two or three men possibly dug in at intervals to pass orders on emergency. The ranging officer with the battery is dug in, probably under a limber in rear of line of guns, with telephone man. Section commanders are dug in close behind wagon bodies. The consensus of opinion of battery commanders seems to be decidedly against observation vehicles. They could only be used on certain occasions and are difficult to drag into position without being seen. Moreover, a battery commander does not feel secure perched up on such a vehicle. He prefers a tree or stack or building of some kind, or else to be dug right in. Climbing irons or dogs, rope ladders, &c., would be of great use. German observatories are never seen now; they are effectually concealed if used.

Ranging.—The keynote is simplicity. Section ranging with percussion—according to information at present available—is the method always used. It is not known if collective has ever been used or not.

Objectives.—More information is necessary before a full report can be made under this heading. Most batteries have never seen any such target as troops in the open or guns in any sort of position. There are exceptions, however, and guns have had to deal with infantry columns crossing the front, infantry advancing in large bodies—crowds—and the rush of an infantry counter attack. In such cases the 18-pr. shrapnel is admitted on all sides as being most efficient. Time is certainly not the important factor that it is at practice. At the open pitched battles as at Mons, Cambrai, situations appear to have been considerably confused, and battery commanders were practically independent except those close to their own brigade headquarters. Telephone communication broke down at once owing to the wires being cut, and any orders that reached battery commanders came by mounted messenger. There appears to have been no visual signalling.

Gun targets.—At the battles just referred to there were cases of guns being located and even knocked out by shrapnel, but these seem to have been rare cases. The covered position is the one adopted and retained to the last. It must be clearly understood that the artillery duel is very much "en evidence." All arms and all ranks agree that the artillery dominates the situation on either side. Its effect is devastating where a target is visible, and infantry, where the strengths approximate to an equality, are quite unable to face it. All efforts are consequently made to establish a superiority in artillery. On the battlefield there is no sign of battle, bar the few bursting shell and a few strips of newly-turned earth, which mark the infantry trenches. Not a man or a gun is visible unless some effort be made to test the strength of some corner of the field; even then it will be invisible to nine-tenths of the front. The chief effort on either side is to locate the big guns by any means. We employ aeroplanes, but the enemy apparently employ an amazingly efficient secret service in addition. The aircraft are always at a height of about 6,000 feet if up at all, and there they appear to be immune from fire. The big gun positions are frequently changed—not less than every two or three days, but ours, however well concealed, are located to a yard by the hostile gunners, and 6-inch or 8-inch high explosive shell dropped right on the guns or in the pits. It is important that these big guns have alternative emplacements always ready for occupation at short notice, after dark, and these should always be irregularly placed with big intervals up to 100 yards, and at varying ranges of 50 yards or so. Inside a wood is often a suitable position. A megaphone in a wood carries well and assists section commanders in these difficult circumstances. Searchlights are hardly used at all. German balloons are always aloft, but our authorities are not in favour of these aids to observation, for reasons which have been thoroughly discussed.

The shooting of the German artillery can only be described as "uncanny." Occasionally great waste of ammunition takes place from, no doubt, faulty information, but parties of troops, whether gun teams, ammunition columns, bivouacs, billets and even headquarters of brigades and divisions have to make constant changes of their position or incur the penalty of having a dozen of the large shells dropped right into them without warning and when least expected. Dummy batteries, observation posts, &c., to deceive hostile aeroplanes, have proved valuable.

Seventy per cent. of our casualties are said to be due to artillery fire, and most of them to the high explosive shell. The "error of the gun" appears to be nearly non-existent, and it is quite common to see four high-explosive heavy shells dropped within 2 or 3 yards of each other. It is difficult to find any explanation for this, possibly the design of shell has much to do with it. The enemy's time fuzes are also astonishingly accurate, particularly those of the field howitzers. Their shrapnel is far inferior to that of the 18-pr. This is admitted by all. There appear to be very few cases of shields having been hit by bullets. Casualties generally result from the backward effect of the high explosive shell. These will quickly destroy a battery when located, but shrapnel from frontal fire never will.

Laying.—There is no direct laying. Our methods have well answered the test of war.

Methods of fire.—Gun fire is evidently very rare, battery fire is the usual method. The largest number of rounds fired by a battery in a day, according to present information, amounts to 1,152 for an 18-pr. battery, but the total number in the war is not double this for the same battery.

Control of fire.—Voice control has been employed in some of the somewhat confused actions referred to above. A Howitzer Battery on one occasion was engaged with infantry at 600 yards, firing shrapnel full charge; voice control was employed. Another battery, the day after disembarkation from the train, had to cover a front of over 180 degrees. It was shot at later from in rear also. Voice control was naturally used, but in the normal action it would never be considered for a minute.

Ammunition supply.—No very definite system has been evolved as being the best. As much cover as possible must be gained both from overhead and from behind if possible. Sometimes both wagons may conveniently be up, or wagon one side and limber the other side of the gun. Replenishment of ammunition is normally by carriers, but may be effected by wagons at night, &c. Limber supply does not appear to have been ordered, but the limber ammunition has often been used up.

Corrector.—Officers do not sufficiently use the table on page 164, Field Artillery Training. The cardinal fault of our shooting would appear to be bursting shrapnel too short; the same applies to that of the enemy.

4.5-inch Q.F. Howitzers.—Never used in brigade at all, often by sections. Time shrapnel ranging with the howitzer is believed not to have been used at all.

60-pr. B.L. has been invaluable. Economy of ammunition is of first importance. It can sometimes be attained by making use of the 18-pr. for ranging purposes.

Entrenching.—Types in "Field Artillery Training" of pits, &c., are not sufficient. Pits for men must be at least 4 feet deep and narrow, but many battery commanders prefer the gun to be in a deep pit. It depends partly on the weather. It is desirable to have a parapet in rear as well as in front on account of the high explosive shell. Solid overhead cover is also desirable as far as possible. The width, 13 feet, is not excessive in bad ground or wet weather.

Map reading.—Map reading forms a very important detail in the daily work of officers and non-commissioned officers, and any work out in the open after dark, and should, therefore, be practised as much as possible.

Signalling.—The amount of work and time devoted to visual signalling have not borne fruit in this war, but the more practice men have with the telephones and the buzzer the better. An enormous amount is dependent on the telephones. Heavy batteries go in for flag signalling with the Observation Officers.

On the whole peace training is proved to have been on the right lines, but from what has been seen much more might be done with the advanced artillery officer. The Germans are said to use him to a great extent. Much has also to be learnt by artillery in their work in conjunction with aircraft. Some notes on this subject will form a heading in a later communication.

HEADQUARTERS,
BRITISH EXPEDITIONARY FORCE,
2nd October, 1914

5: Memorandum on the Possibility of Undertaking Offensive Operations

Source: WO95/154

APPENDIX A

SECRET

1. Although we are for the moment acting on the defensive, it is necessary that we should be prepared to undertake offensive measures; and in considering them we must realize the conditions of warfare in which we are now engaged.
2. A stage has now been reached in which the principles of fortress warfare rather than those of field warfare apply. It would now no longer be practicable to carry out a general offensive, or for the whole line to advance.
3. When the length of front, the number of guns, and the expenditure of gun ammunition are taken into consideration it is apparent that such an operation is beyond the powers of either of the opposing armies.
4. If the Germans are to be defeated they must be beaten by a process of slow attrition, by a slow and gradual advance on our part, each step being prepared by predominant artillery fire and great expenditure of ammunition.
5. Our *supply of ammunition* and available reserves *being what they are* it is clear that we cannot bring about this attrition by attacks all along the line. We must concentrate our efforts on one part of the enemy's line and resolutely persevere till success is achieved. [marginal "?" by Douglas Haig]
6. To bring this about, we should choose one part of the enemy's line where by virtue of our relative positions we are already at a tactical advantage, or where in the event of our attack being successful he will be compelled to withdraw to a position where he is unfavourably situated in comparison with his present position. This tactical advantage virtually resolves itself into an advantage in so far as the employment of artillery is concerned, that is to say, the combatant who can attack with the help of observed, and better still, observed converging artillery fire, is at a great advantage over the opponent, and he similarly gains a great advantage if, when he has gained his position he is able to bring observed artillery fire on or in rear of the position the enemy has retired to.
7. In comparison with this artillery advantage other tactical advantages are of minor importance, for in this campaign there has been abundant proof that in so far as rifle fire is concerned disadvantages can be rectified by artificial means or by suitable use of buildings or natural obstacles. It may, in fact, be asserted that terrain and topographical features do not appreciably assist the attack or defence except in so far as the artillery advantages referred to above are concerned.
8. Assuming that we concentrate our energies on one portion of the enemy's front, it is necessary to consider *firstly* against what portion we are already at the best tactical advantage and *secondly* what advantages we would gain in this respect if the enemy is driven out of his position. Assuming that our line extends as at present from CUINCHY Northwards, that is to say that the I Corps front is not given up, two positions and two portions alone stand out as affording in a greater or lesser degree the tactical advantage referred to above.
9. The VIOLAINES plateau, including LA BASSEE, commands

ground to the N.E. and E. Its capture would deny the enemy the use of the LA BASSEE-LILLE Road and overlooks for some distance the LA BASSEE-LENS Road. Successful operations here would greatly assist an advance on the part of the French from VERMELLES. In fact, no material advance can take here unless the VIOLANES plateau and LA BASSEE are captured.

An attack however on this plateau is a very difficult matter and would in the first instance [marginal "?" by Douglas Haig] be undertaken at a disadvantage, in so far as observed artillery fire is concerned. The enemy is very strongly ensconced in the LA BASSEE triangle and his Machine Guns are comfortably sheltered under the protection of the railway embankment behind slag heaps and mounds. To capture this triangle would involve a great expenditure of ammunition. Opposite GIVENCHY, too, the enemy is very strongly entrenched.

Even if the LA BASSEE triangle and the hostile trenches opposite GIVENCHY are captured there is no guarantee that we should be in a position to capture LA BASSEE. The taking of this place would probably involve sapping operations similar to those undertaken by the French against VERMELLES.

10. *Taking everything* into consideration, viz:- the disadvantages under which the operations would be undertaken; the time taken to achieve the object; and the losses that would probably be entailed, we may arrive at the conclusion that an attack on this section of the front would be a very difficult matter. [Marginal "YesIf attacked by the writer of this proposal!" by Douglas Haig.]

11. Examining our line further Northwards the best tactical advantage we possess over the enemy is to be found at the reentrant to the west of the MESSINES and WYTSCHAETE ridge. The enemy's defences here are abnormally strong, but from an artillery point of view we have a great advantage. With observation from Hill 75, which could probably be captured fairly easily, with converging artillery fire from Hill 63 to the South and from good positions to the West and North West of WYTSCHAETE, we should be in a position gradually to prepare the way for an infantry attack on the enemy's trenches.

12. The capture of the ridge would materially straighten out the YPRES salient and rectify our disadvantages there and thus tend to remove our anxiety in that quarter. From this ridge, too, observed artillery fire can be brought to bear over a large area of country to the Eastward, and although it is problematical how far the enemy would be compelled to retire after losing the ridge, it is a fair assumption to make that occupation of HOUTHEM and WARNETON would become uncomfortable and an attack on our part Southwards against HOLLEBEKE would be made comparatively simple.

13. It is not within the scope of this paper to discuss how the attack against the WYTSCHAETE-MESSINES ridge should be carried out. Whether WYTSCHAETE should be attacked before or after or simultaneously with MESSINES, or whether MESSINES should be attacked simultaneously from the South can only be decided after full discussion with the commanders specifically entrusted to carry out the operation. It will be sufficient to say that we start here with a great tactical advantage over the enemy and these tactical advantages increase if the ridge is placed in our possession.

14. It its not for one moment contemplated that this plan can meet with success after a day or so's fighting. It will entail methodical plodding operations alternating between success and failure, and entailing considerable losses and a free expenditure of H.E. and lyddite ammunition. How much more ammunition will be necessary than we have at present is a matter for conjecture and can best be foretold by artillery experts, but it will have to be expended on a scale more lavish than has been the case hitherto. Further, we should need at least one Corps or its equivalent to take part in the attack in addition to the troops now holding the trenches.

15. It should also be borne in mind that owing to the time necessary for preparation, viz:- siting of guns, registration of targets, rehearsal and preparation of trenches from which the attacking infantry are to advance, it may take from a fortnight to three weeks after the plan is commenced to be put into force before the first attack can be delivered.

16. Given ample ammunition, at least one Corps in addition to the troops now holding the front, careful preliminary preparation in every detail, and determination to go right through with the business in hand, we ought to have a reasonable chance of success. If we cannot succeed here, it is hopeless to expect success on any other portion of our line except in the capture of a trench here or there, which would have little material effect on the enemy.

17. The 1st Army to investigate the question of an attack across its front as referred to in paragraphs 9 and 10 above, and forward its proposals for the information of the Commander-in-Chief.

The 2nd Army to investigate and report similarly in regard to the attack referred to in paragraphs 11 to 16 above.

[signed W. R. Robertson]
Lieutenant-General,
Chief of the General Staff
G.H.Q.
8-2-15

6: 1st Army Methods for the Attack, 13 April 1915

Source: WO 95/155
[stamped (1) "SECRET" (2) "1st Army General Staff No: G.S. 73(a) Date: 13.4.15"]

Corps
Divisions
Brigades

1. The instructions contained in 1st Army Secret Memorandum dated 2nd April are cancelled so far as the operations therein referred to are concerned. The general principles referred to are embodied in the attached instructions—PAPER 'B.'
2. The operations for which preparation is now being made are intended to be much more sustained, and it is hoped that they will lead to more far reaching results than could be expected from those at NEUVE CHAPELLE.

   The object is to co-operate with a vigorous offensive which is to be made on a large scale by the French with a view to breaking the enemy's front for a considerable width and then to follow up by such action as will cause a general retirement of a great part of the enemy's line.

   Our objective is, therefore, not a local success and the capture of a few trenches or even a portion of the hostile position on a more or less extended front, but to employ the entire force at our disposal and fight a decisive battle.

3. The general instructions for the attack are attached—PAPER 'A.' All details will be worked out by Corps and Divisions concerned on the same lines as those for the attack on NEUVE CHAPELLE, and will be submitted to Headquarters, 1st Army, at an early date.
4. Forming up places for attacking troops and reserves must be carefully reconnoitred, and the construction of lines of breastworks, trenches and screened approaches put in hand at once, so as to get all the troops necessary for the attack up as close as possible.

   All troops will be rehearsed in detail beforehand in the actual way in which they are to get into and out of their forming up places.

5. Registration of targets will be proceeded with without delay, and carried out gradually so as not to disclose the fact that an attack is projected.
6. Attention is directed to the following papers issued by 1st Army Intelligence:
   1. Area occupied by the 7th German Corps.
   2. Country between LILLE and the present German line, (which will be issued during the next few days.)

/s/ R. Butler.
Brigadier-General

General Staff, 1st Army.
13th April, 1915.

Paper 'A'. General Instructions for tThe Attack.

7. The 1st Army will operate so as to break through the enemy's line and gain the LABASSEE-LILLE road between LA BASSEE and FOURNES and then advance on DON.
8.
    a. The 1st Corps, maintaining its right at GIVENCHY, will attack from its breastworks in the vicinity of RICHEBOURG L'AVOUE on as broad a front as possible and advance on RUE DE MARAIS-ILLIES.
    b. The Indian Corps will operate so as to cover the left of the 1st Corps and will capture the FERME DU BIEZ. Its subsequent advance will be directed on LIGNY-LE-GRAND-LA CLIQUETERIE FARM.
    c. The 4th Corps will operate so as to break through the enemy's line in the vicinity of ROUGES BANCS with the object of: —
        1. Organizing a defensive flank from the vicinity of LA CORDONNERIE FARM to FROMELLES, and
        2. Turning the AUBERS defences by an attack from the N.E. The subsequent advance will be directed on LA CLIQUETERIE FARM, with a view to effecting a junction with the Indian Corps.
9. The 2nd Cavalry Division will remain near ESTAIRES in readiness to act as the situation develops.

Paper "B". General Principles for the Attack.

10. The enemy is to be beaten on a certain length of front and driven out of it, and must not be allowed time to reform in rear of the captured trenches.

    For this a violent and continuous action is required.

    The keynote of all the work, both as regards details and the general idea, is offensive action.

    When once the enemy's front system of trenches is broken, delay is usually the chief cause of failure and heavy casualties.

    Commanders must, however, bear in mind that, once the enemy's line is broken, it is the intention to follow up by such action as will cause a general retirement of a great part of the enemy's line. Thus the operations will be continued during a considerable period.

    Supports and reserves.

11. Bearing the above in mind, it is of the highest importance that all commanders should consider carefully the handling of their reserves to maintain the forward movement.

Under the existing conditions, only one definite offensive blow can be expected from one body of infantry, and therefore fresh troops must be pushed through those making the first attack to develop the success won. Troops heavily engaged during the day should not ordinarily be expected to continue the offensive on the following day, but should be either actually relieved or arrangements made for fresh troops to pass through them. The organization of reserves in depth should be made with this object.

Supporting and reserve troops must be close up from the commencement of the operations, so that they can follow close on the heels of the troops in front. Commanders of such troops must clearly understand the objective and their role, and use their initiative.

Ample cover must be provided for the reserve troops well forward, with good and sufficient communicating trenches. Direction boards must be put up to prevent mistakes in the existing labyrinth of trenches.

The Infantry attack.

12. Infantry commanders must know the time table of artillery fire, and regulate their progress and time their assaults in accordance with it.

The attack on the front trenches will probably not be equally successful all along the line. Support must be given at once to the units which have been successful to enable them to press on. Where unsuccessful a new attack must be organized from a flank where the line has been broken.

If a certain body of infantry fails to gain its own particular local objective, there is no reason why the troops on either flank should be held up. Every body of infantry must push on and thereby facilitate the task of the troops on the right and left.

The whole operation can be regulated with the greatest precision. Parties of infantry should be detailed beforehand for the capture of the several localities at definitely stated times in accordance with the artillery time table. The accuracy of the photographic maps permits of this being done.

We must not wait to be counter attacked, but must follow up our attack at once. Infantry must push on, and field guns, trench mortars, machine guns, etc., must be pushed forward in close support of the attacking infantry to batter down houses, etc. The responsibility for supporting the attacking infantry in this way rests with Infantry Commanders, and special guns will be allotted to them for this purpose.

Localities must be seized promptly to act as supporting points to further advance, but only the necessary number of men will be left to entrench each of these points.

All ground gained will be secured (F.S.R. Part I, Sec. 105 (5)).

Artillery

13. The artillery objective is not only the wire entanglements and front trenches, but the whole position, with a view to destroying the hostile infantry, actually and morally (i.e. second line, communication trenches, shelters, etc., must be systematically dealt with.)

The task of the artillery is: —

. The support of the infantry during its attack.
a. To gain superiority of fire over the hostile artillery.

The artillery fire will be time-tabled and registered as far behind the enemy's front line trenches as possible, with due regard to range and accuracy.

The guns must be registered beforehand on all the objectives and tactical localities as far forward as possible.

Similarly, the barrages of shrapnel must be arranged beforehand. These will be gradually expanded as the infantry advances.

The nature of the artillery support required by the infantry depends on the local conditions of the fight.

Some field or horse artillery guns must be ready to push forward rapidly in support of the infantry as the latter get beyond the support of the remaining guns. (Field Artillery Training, Sec. 156 (4).)

Special Parties

14. Special parties must be detailed for work subsidiary to the attack, such as bomb parties, sandbag parties, bayonet parties, entrenching tool parties. These parties must all be conversant with their various duties.

The idea of the offensive must be inculcated in the grenadier parties, so that their efforts are directed to bombing so as to assist the movement to front and flank, rather than to more defensive work and blocking approaches.

Special attention must be given to repairing roads, and detachments of R.E., with infantry working parties attached, must be organized and in position to follow up the attack, for clearing away obstacles and mending roads, to allow free passage for our troops.

Special parties for extending and maintaining the telephone wires must also be organized beforehand (see paragraph 7).

R.E. Stores & Materials

15. Advanced depots of R.E. stores must be established close up behind our own lines at short intervals along the front of the attack. These depots should contain material for entanglements, sandbags, trench-bridging materials, tools, etc.

Parties of R.E. with infantry must be specially detailed to move forward with these stores to secure positions gained.

The experience of NEUVE CHAPELLE gives a good indication of the nature and quantities of stores required for any given length of line, and estimates should be framed accordingly with regard to the length of the probable successive lines likely to be required to be placed in a state of defence.

Communications.

16. In order that the offensive may be continued without interruption and be suited to the changing conditions of the fight, the several commanders must be kept in close touch with the situation: hence communications must be carefully organized beforehand and adequate means of getting information back from the front provided. Wherever possible communications should be triplicated and arrangements made to carry on communications by flags, lamps, etc., when wires are broken. This is of the first importance, and all commanders will give this matter their close attention.

The ground over which the attack is to pass and the localities to be attacked can in most cases be seen and studied. So far as is possible, therefore, arrangements should be made beforehand between what points communication by flag or otherwise is to be established as the attack progresses.

The positions of commanders must be carefully thought out and suitably protected points organized for commanders near their troops.

Telegraph and telephone wires must be buried up to our front trenches, and arrangements made to push wires on as soon as possible after the attack has passed beyond them.

Staff officers must be pushed well forward with the object of collecting information and keeping commanders regularly informed of the situation.

With this object in view, positions of observation and dugouts should be made, and special communications established beforehand with these places.

Special attention must be given to instructing signal companies in their duties and action during an advance, and all preparations must be made with a view to the forward movement being sustained.

Divisional Cavalry and Cyclists.

17. Divisional Cavalry and Cyclists must be kept handy to push on rapidly as opportunity offers, to anticipate the enemy in occupying houses and other tactical points, and so facilitating the advance after the enemy's main lines of defence have been broken

7: SS24, "Object and Conditions of Combined Offensive Action," June 1915

SS 24. Translated from the French and issued by the General Staff at General Headquarters, June, 1915
Source: IWM SS/CDS Pamphlet collection

General Headquarters, Eastern Armies
General Staff, 3rd Bureau,
OBJECT AND CONDITIONS OF COMBINED OFFENSIVE ACTION.
General Headquarters, 16th April, 1915.

Object.—The object of an offensive action is not merely to gain possession of a line of enemy trenches but actually to drive the enemy from his entire position and to defeat him, without giving him time to reorganize.

Preparation.—An operation of this nature cannot be improvised off-hand. The test of repeated experiments has proved that elaborate organization and preparation are indispensable conditions for success. This preparation must leave nothing to chance and must bring about, before launching the attack, all the conditions favourable to its execution.

This does not absolve the higher command from the obligation of guaranteeing by every possible precaution the secrecy of the operations in view and of securing for the attack the advantage of surprise.

Officers commanding the higher formations, commanders of infantry units detailed for an attack, and battery commanders whose function it is to support it, must have made themselves familiar with the ground to be attacked not only by means of "plans directeurs" and photographs, but also by personal reconnaissance on the spot, in order to ascertain the nature of the obstacles which must successively be surmounted, arrange for their destruction, and determine the role of each body of troops concerned.

In the distribution of units special attention will be paid to the degree in which each of them may have familiarised itself with the ground.

The ground must be prepared in such a manner as to enable the attack to be launched in close proximity to the enemy, and to secure an uninterrupted supply of men, rations and ammunition, the rapid evacuation of casualties to the rear, and to facilitate the movement of artillery.

The whole attack must be carried out on a broad front in order to secure results of sufficient importance and to obviate the possibility of flank attacks on the part of the enemy.

The large formations which are to be first engaged (i.e., Army Corps, Divisions) will be aligned in depth with a narrow front allotted to each, in order to secure for the operation both continuity and weight.

It will have been the role of the artillery, by systematically directing its fire on the successive lines of the enemy's positions, to destroy his defences, and to break up his dug-outs, communication trenches and flanking works. It will have lowered the moral of the defenders by repeated shock and will be in readiness to afford effective support to the infantry attacks, throughout their duration, not only on their original but also on their ulterior objectives.

Up to the moment of the attack, the infantry will be held under cover at points of assembly prepared in echelon behind the firing line and affording an easy egress to the front. The troops will be provided with all the necessary material for surmounting and destroying obstacles and for action at close quarters.

The assaulting troops, at all distances, will be imbued with the idea of breaking through, of going beyond the first line of captured trenches, and of continuing the attack without inter-mission till the final result is obtained.

Execution.—The complete preparation of the attack being an indispensable condition for success, it follows that its execution must be regulated by the completion of this preparation, and must especially depend upon the securing of the results aimed at in the artillery preparation.

Higher commanders must satisfy themselves, either personally or through their liaison officers that all the precautions laid down have been complied with, and the necessary results obtained. The responsibility is theirs.*
[* It is, therefore, impossible to decide any considerable time in advance the moment when an attack can be launched, since this depends on the degree of preparation, atmospheric conditions, visibility, &c.]

The infantry will rush forward to the assault under the protection of walls of fire created by the artillery, with the object of paralysing the enemy's counter-attacks, and assisted by counter-batteries, whose role is to silence the enemy's artillery.

This attack must take a sharp and violent form, and will be driven home without intermission, or any loss of continuity, till the final result is obtained by means of the unceasing entry into action of fresh units on the front.

It will require a vigorous command, determined to push on to the end, and keeping in close and uninterrupted communication with the combatants, so as to be in possession of an exact idea of the situation at any moment, and to control the combat throughout.

Finally, it demands in all subordinates the conviction that trench warfare can and must cease, and that this result depends on their vigour, their tenacity, and their belief in their own physical and moral superiority.

The notes appended demonstrate the conditions governing the application of these principles.

They also set forth certain means of execution which have successfully passed the test of recent attacks, and the use of which, with suitable modifications, according to the ground and local conditions of each individual attack, is to be recommended.

J. JOFFRE,
General Officer Commanding-in-Chief.

APPENDED NOTE No. 1.

The Infantry Attack

Objectives.—In a concerted offensive action, it is important that it should not be considered sufficient to assign to the infantry as objective the first line of enemy trenches.

There obviously exists a risk of seeing the whole line of attack halt to reorganize in the captured trench, and subsequently await the enemy's counter offensive, and by so doing leave him complete freedom either to prepare his counter-attacks or to re-establish himself in rear.

The only result obtained by such a procedure, consisting of a series of successive attacks separated by intervals of inaction, is gradually to force the enemy back, without however making him the object of the uninterrupted pressure which will render it possible to defeat him.

In order to secure the requisite continuity of action, it appears advisable to give the attacking units as their objective points in rear of the enemy's fortified position, the possession of which will be a guarantee that the preliminary result to be obtained, i.e., the piercing of the enemy's line—has been secured.

In aiming at the possession of these points, the attacking units must regard the enemy's trenches not as an end in themselves, but as a series of barriers which must be penetrated before reaching the objective laid down.

Strengths.—Having regard to the efforts which must be devel-oped in order to carry a fortified position, the infantry must more than ever be organized in a manner calculated to assure its staying power.

The higher formations will therefore be disposed in depth and engaged on a narrow front, (1,000 to 1,200 yards per division) at that part of the line where the decisive effort is to make itself felt.

In the new form which it has assumed, the infantry combat opens with an assault. The phase consisting of a progressive advance towards the enemy of a firing line of increasing density no longer exists.

It follows that as a general rule, and at all events in the principal sectors of the attack, the firing-line must develop from the outset the maximum density compatible with effective use of the arm, roughly one man per yard, or one company on a front of 200 yards.

The whole effective of each company in the firing-line will enter into action simultaneously.

Reinforcements will be brought up in successive lines, the strength and intervals of which will depend upon the situation of the moment, without, however, departing from the principle that, once launched, the attack must be carried out with the greatest possible rapidity, without intermission, and with the utmost determination. Local reinforcements below the strength of a company are to be avoided.

Formation.—The best formation in which to approach the enemy is usually open order one rank deep, which alone allows of immediate and simultaneous action by all the units co-operating in the attack. This formation will be adopted in the parallel from which the attack starts; by these means the individual soldier will merely have to advance straight to his front on the order to attack being given.*
[*The attacking body has occasionally been formed up in small columns consisting of a section or half a section on a 4 or 8-file front.]

On reaching the enemy's first line defences, the portions of the attack immediately in front of the breaches will be the first to enter the enemy's trench; those on either side of them will be able to follow through the same opening. The others will lie down for the time being behind the wire entanglement, making the utmost use of the available cover, and will endeavour to take advantage of every circumstance enabling them in their turn to pass the obstacle.

Acting in a similar manner as the first line troops, the reinforce-ments will usually debouch in open order one file deep. Brought forward in good time to the trench from which the attack is launched, they will deploy there in the same manner as the troops which have preceded them, at distances varying according to their strength.

Later, when the progress of the attack has rendered possible the construction of further communication trenches extending to the captured trenches, they will be able to extend the covered line of approach as far as the latter and to use them as their deploying-points.

This is an undesirable formation, in open country, at all events. It is vulnerable; it approaches the objective on a narrow front, and finally there is the risk of defective cohesion during the advance, and consequent loss to the soldier of the feeling of mutual support at the moment of impact.

The considerations which have led to the occasional adoption of this formation have been either the inadequate provision of outlets from the trenches whence the attack starts or the desire to take advantage of breaches created in the enemy's defences.

The first difficulty may easily be avoided by suitable preparation of the trench. As for the second, the intention of immediately making for the breaches cannot justify an advance in column under fire across a space of from 150 to 200 yards.

Progress of the attack.—The preliminary dispositions preparatory to the assault will be made immediately before the attack, in order that the troops may enjoy as long as possible the protection afforded by the dug-outs. The signal for the attack will be given either by bugle-call or by means of rockets.

As a rule, the first line will advance for the attack during the last stage of the final bombardment. (See note on the use of artillery.)

When the artillery fire is well controlled, the infantry can leave the trenches as soon as the final bombardment commences; it then advances under cover of the salvos in order to assault the enemy's trench the moment the artillery ceases to fire on the garrison.

Each unit will march straight to its front, on points previously detailed, with fixed bayonets, and as a rule without firing.

If the artillery preparation has been thorough, the entire line can advance as one man, at the walk. This is by far the best method.

In other cases, the line must advance by a series of bounds, a portion at a time. In these circumstances care will be taken that no advance is attempted by any fraction less than a company.

The attacking line will advance as far as the first enemy trench, will throw grenades into it, and will then cross it and vigorously continue its forward movement, under the protection of the wall of fire provided by the artillery, leaving the groups of bomb throwers, supported by certain bodies of troops previously detailed for the purpose, the task of getting down into the trench, clearing it, and establishing themselves therein.

Immediately following the departure of the first line of the attack, a line of reinforcements will have come up to man the trench from which the attack started. It will debouch at a short distance behind the first line (from 50 to 100 yards) taking advantage, like the latter, of the period of effective fire of the artillery.

These reinforcements must not halt when they reach the captured trench, but will join the most advanced troops in order to assist their progress. The subsequent lines of reinforcements will come up in succession in the same manner.

Engineer detachments will accompany the first reinforcements and will be employed in organizing the captured trench.

Machine-guns will be brought up into this trench immediately it has been occupied with a view to checking counter-attacks and assuring possession of the ground captured.

At the earliest possible moment, trench mortars will also be brought up. After this first assault, it will be absolutely essential to establish communication trenches between the original trench and that captured, in order to avoid the wall of fire created by the enemy's artillery.
(See note on the preparation of the ground to be attacked.)

Pending the establishment of regular means of communication, and to supplement them when established, arrangements will be made for the use of pre-arranged signals, made by means of flags or other signalling apparatus, which will enable the units in action to give a summary account of their situation.

The attack will continue without interruption or respite, day and night, until the final result; regimental officers in front making every effort to push on, while the higher command in rear concentrates on the task of feeding the combat as it progresses, or organizing fresh efforts against the points which offer a prolonged resistance.

It will be incumbent on those in every sphere, from the firing line backwards, to exploit immediately any local success, either directly or for the benefit of neighbouring bodies which have been less successful, assisting their advance by flank movements issuing from the captured positions.

Advantage will be taken of night to relieve exhausted units; after being passed by fresh bodies of troops, which will immediately take up the task of pursuing the attack, the former will rally on the spot under the nearest cover with a view to re-forming and subsequent employment.

As a rule, this relief does not imply the return of the troops previously engaged to the rear. This procedure, though obligatory in the case of troops occupying trenches, is justified in the course of an attack only when the lengthy duration of the attack renders it indispensable.

It may be considered that a division can maintain a continuous and violent effort for a matter of several days, in the course of which its reserves will enable it constantly to feed the firing line with fresh troops.

Position of commanders.—The commanders of an attack must place themselves near the front in a position permitting them to see the field of battle, and enabling them to exercise a constant and immediate action on the conduct of events.

The report-centre of a battalion commander or regimental commander should be situated in the trench from which the action starts, that of a brigadier-general on a level with the dug-outs of the first or second lines, that of a divisional commander near the first reserves of the division.

(These posts will be constructed according to the instructions in the note on the preparation of the ground for an attack.)

They must not remain invariably fixed in their original position. The common tendency to adhere to a particular point in order to enjoy the advantage of the communications which have been arranged and of existing telephones is wrong. A report-centre should be shifted every time that the progress of the attack renders such a move necessary, in order to continue to overlook the scene of the attack, and to assure the direct action of the commander on the troops. The pushing forward of report-centres will further be attended by the happiest moral effect on the troops in action.

Material organization.—The infantry must develop in the minutest details the material preparation for the attack.

Each man will be provided, as a rule, with 250 rounds, 2 days' rations, and a few grenades. The entrenching-tool will be fixed on the belt before the start, and water-bottles will be filled.

Grenade throwers will be equipped with firing wristlets.

Units detailed for clearing the trenches will be provided with special arms (revolvers, clasp-knives); parties provided with wire-cutters, charges, and the Filloux wire-cutting apparatus* will be distributed along the front.
[* A notched tube adjusted on the muzzle of the rifle.]

Special reserves of small-arm ammunition and grenades will be arranged in the starting parallel for each company.

Sufficient provision will also be placed there of wire, stakes, sand-bags, tools, flags, telephone apparatus, &c. A portion of these stores will be distributed to each unit before the start.

The bodies whose duty it will be to keep the units in the firing-line supplied with ammunition and materials will be detailed in advance and organized with a view to their employment.

Posts for cleaning rifles will be provided, and so forth.

All units which are to accompany the first line of the attack or to follow it will receive special instructions, clearly defining the duties allocated to them and enabling them to make suitable preparations (i.e., parties of telephone operators, signalling parties, grenade throwers, bomb throwers, machine gunners, detachments of ration carriers, detachments of workers to be employed in making communication trenches, &c.).

The means of bringing up rations, and especially of assuring a supply of water, no less in the firing line than in the existing works, will be studied and arranged for before the attack.

It is vital that every detail should be foreseen and minutely provided for so that it shall be impossible for the carrying out of the attack to be hampered or delayed, in any circumstances, by details of this nature.

APPENDED NOTE No. 2.

USE OF ARTILLERY.

The determination always to push further forward by means of a continuous action demands in the case of the artillery an extremely perfect preliminary organization and a minute study of its eventual movement.

The artillery opens the path for the infantry. Its objects are :—

a. The destruction of the enemy's defensive works.
b. Effect on his personnel.
c. Action on the enemy's batteries (counter-batteries).
d. To accompany the attack (batteries detailed to move forward with the infantry).

The selection of objectives and their distribution among the different batteries involves—

5. An elaborate study of the plan of the enemy's works supplied by aviators and kept up to date.
6. Detailed reconnaissance of the actual ground (no less with a view to selecting the emplacements of our own batteries than for the discovery of defiladed targets and the designation of the batteries which are to fire upon them).

Since the artillery has to fire not only on the first line but also on the whole of the enemy's position and must be able to silence the enemy's batteries, frequently at a considerable range, it is absolutely essential, from the outset, to open with the artillery well forward in order to avoid changes of position which would either be impossible under fire or would delay its action.

A. Preparation of the Attack.

Destruction to be effected in the course of preparation.—The artillery fire must—

g. Destroy the accessory works.
h. Break down the first line trenches, the dug-outs behind them, the second lines and communication trenches.
i. Do as much damage as possible to the flanking-works, and be ready to fire on them immediately, should they only be discovered at the moment of the attack.

Registration.—Artillery fire is effective only when it has been possible to register with extreme precision.

In many cases, this accurate registration requires the assistance of air-craft or balloons.

It is often advisable that it should be carried out by each gun in succession. For specially accurate fire, or when dealing with material whose elevating gear is worn out, spirit-levels of the 1886 pattern may frequently be used with advantage.

Fire control during the preparation.—The duration and control of the preliminary bombardment are not the same in the case of heavy artillery and of field artillery.

The following results of experience are laid down for the guidance of commanders :—

In the case of the heavy artillery, after preliminary registration and control of fire, a period of from 3 to 4 hours may be given as the limit of effective preparation. This period is calculated on a basis of the number of rounds to be fired on each definite target, in the course of a regular

bombardment, in order to produce a satisfactory result. Except where the target offers an exceptional resistance or covers an unusually large area, this figure may be estimated at from 40 to 50 rounds per gun for the 220 m., 50 to 60 for the 155 m., 60 to 80 for the 120 m.**
[** These numbers constitute a mean and can only be regarded as a guide. In practice, results have varied considerably.]

In the case of the field artillery, it is often advisable to divide the preliminary bombardment by a pause for the purpose of verifying its results. In all, from 80 to 100 rounds per gun should suffice (registration having previously been effected).** The use of prolonged and rapid fire, which results in accidents of every description, is absolutely forbidden.*
[* The rate of fire for a 75 m. must never exceed 4 rounds per minute, and this rate must not be maintained without a break for a period of more than 10 minutes.
[**These numbers constitute a mean and can only be regarded as a guide. In practice, results have varied considerably.]

In certain circumstances, it will be necessary to resort to con-tinuous bombardment, day and night.

In any case, the artillery preparation must cease only when the necessary results have been secured.

Destruction of defences.—For this purpose, the 155 howitzer may be used in conjunction with the 75. The number of batteries to be employed depends on the number of breaches to be opened. Experience has established as a minimum the use of one 75 battery to every 200 yards of front.

It will be desirable to destroy simultaneously the defences of the first and second lines. Should the number of batteries at the disposition of a commander not admit of this, the second line defences will be destroyed first, followed by those of the first line.

Bombardment and destruction of trenches, dug-outs, and communication trenches.—These operations will be carried out by the whole of the available artillery simultaneously with the destruction of the accessory defences. As soon as the latter has been effected, the 155's and 75's, which were detailed for that purpose, will in their turn take part in the bombardment. (It is advisable to allocate one 75 battery to every 100 yards of front.) Bombardment immediately preceding the attack, and complementary action against the garrison of the enemy trenches.—The attack must only be launched after it has been established that the accessory defences have been destroyed. It will be preceded, as a rule, by a bombardment by the whole of the artillery. The bombardment takes the form of "rafales" broken by periods of silence of unequal duration.

The last part of several of these "rafales" can be marked by a series of salvoes so as to make the enemy imagine that an infantry attack is imminent.

The all-important factor is to keep the enemy in a state of uncertainty as to the actual moment of the assault, so that he may man his trenches prematurely and so be exposed to the fire of the last "rafales."

If the enemy commences to form walls of fire prematurely, advantage must be taken of it by trying to mark down his batteries and silence them. Preparation by trench mortars, &c.—When circumstances do not permit of artillery preparation being carried out with sufficient certainty, especially where this is due to the lie of the ground, the preparation will be secured or completed by trench howitzers (80 and 65 mm. pieces, &c., and especially the 58 and trench mortars.)

These will be advanced as near as possible to the enemy's line, in sufficient numbers (one 58 to every 30 yards, roughly, of front to be attacked) with an adequate supply of ammunition, for which covered magazines will have been arranged. The preparation by this means will only commence at the desired moment, in time to produce the effect aimed at, and will consist of systematic and continuous fire.

B. Development of the Attack.

At a pre-arranged signal, or, in certain circumstances, at the moment fixed for the infantry attack, the artillery increases its range progressively*, in order to create in advance and on the flanks of the attack a longitudinal and transverse wall of fire, under cover of which the infantry can advance.
[* It is important not to give the enemy the impression of an interruption in the continuity of our fire.]

As soon as the infantry has reached the enemy's first line, the artillery carries out its role of preparation on the communication trenches and on the second and third lines, and also details batteries to move forward with the infantry in the same manner as was previously done against the first line: it fires on any machine guns whose positions happen to be revealed; it opposes all counter-attacks, making use, within reasonable limits, of rapid fire. Batteries detailed to move forward with the infantry.—In order that the action of the artillery may be assured, and in order that it may act uninterruptedly and in close co-operation with the attacking infantry, it will be necessary to arrange for a number of 75 batteries and even of heavy batteries to move forward.

For this purpose, emplacements will be prepared, routes under cover will be reconnoitred, appliances for crossing obstacles will be provided and teams will be kept close to the guns.

It will have been possible, during the period of preparation, to push forward certain batteries or sections whose role is to open fire only when the action develops.

It is also indispensable to arrange for trench mortars and similar material to be moved forward at short notice. Counter-batteries.—One of the first duties of our artillery is to engage and silence at all costs the enemy's batteries, whose positions must have been located in advance or are to be searched for throughout the course of the engagement by every possible means (observing stations, balloons, aeroplanes, &c.).

It will often be advisable to use 75 mm. batteries as counter-batteries, when distance permits; where this is not the case, the heavy artillery will be employed for this purpose, every effort being made to develop the utmost possible rapidity of fire.

C. Position of Report-Centres and Organization of Communications.

The primary condition of effective artillery action is the organization of forward observation and of close touch with the infantry.

The position of artillery report-centres, as a rule, will be identical with those of the infantry commanders.

The artillery, however, must always have at its disposal a system of telephonic communication of its own, linking up the report-centres, observing stations, and batteries.

Observing stations are of two kinds—

j. Those whose role is to search for and discover objectives (and which are in dirct communication with the artillery commander).\
k. Those whose role is to observe fire (and which are attached to individual groups).

It is advisable to multiply these observing stations, without necessarily occupying them all simultaneously. They usually consist of shell-proof shelters. Use may be made, especially in wooded country, of ladder observing stations.

Observers are detailed from personnel carefully selected and trained for this purpose. Observers whose duty is to observe fire must be placed as near as possible to the targets, almost invariably among the first lines of the infantry.

In addition to fixed observers, arrangements may be made, in the case of certain batteries intended to come into action during the development of the engagement, for mobile observers, officers and non-commissioned officers, who will march with the infantry commanders and will be accompanied by the personnel required to carry the appliances necessary for rapidly establishing communication.

Moreover, steps must be taken to provide for the progressive advance of observers throughout the development of the action.

Co-operation between the artillery and the infantry is secured by the mutual proximity of artillery and infantry commanders, and by placing artillery observers near the commanders of the lower infantry formations.

As a rule, it devolves upon the artillery officers in the trenches to convey the requirements of the infantry to the batteries, according to the information given by the infantry officers (battalion commander, captain, &c.).

The telephone lines required for the operations of the artillery during the preliminary bombardment and the attack (three sets of independent lines wherever possible) should be laid either in the communication trenches, or better still, along the drainage channels (from 10 to 18 inches deep) running along the edge of the communication trenches. This method not only facilitates repairs but also lessens the risk of the wires being cut by the enemy's shells, or by the movement of troops.

The telephonic communications must be supplemented by visual communication arranged for by special methods.

It will also be necessary to make use of prearranged signals between the infantry and the artillery, such as red or white rockets, to ask for the cessation of fire, increase of range, or a renewal of activity by the artillery.

Wherever there is danger of ambiguity arising, our infantry line, or our first-line trenches, will be marked by a series of flags or white and red discs, hidden as far as possible from the view of the enemy.

APPENDED NOTE No. 3.

PREPARATION OF GROUND TO BE ATTACKED.

In order that the infantry may attack under favourable con-ditions, and be capable of a continuous effort, it must—

12. Advance under cover to within close range of the enemy and deploy there.
13. Be constantly fed with fresh troops.

The ground must be prepared in such a manner as to comply with these conditions, which require a starting trench from which the troops will debouch for the attack, fortified points designed to provide cover for reinforcements within a short distance of the firing line, communication trenches guaranteeing, in spite of the enemy's artillery, the continuous feeding of the attacking troops, and the evacuation of casualties.

The details of the organization will vary according to the dispositions adopted for the attack. In any case, this organization is secondary to those dispositions, and the latter must be decided upon sufficiently in advance to allow of the execution of the necessary works.

Parallel from which the attack starts.—This will consist of the fire trench, or better still a "starting parallel" in advance of it, and sited in front of our own defences.

Carried out along the whole extent of the attacking front, and parallel to the enemy line, it will be occupied in succession by the first line of the attack followed by their reinforcements for the purpose of their initial deployment.

The distance between this parallel and the enemy's first line will be as a rule from 150 to 200 yards, in order to be as near as possible to the first objective of the attack without giving ground for apprehension of the effect of one's own artillery during the period of immediate preparation.

It must be easy to debouch from, for which purpose steps will be arranged throughout its length.

In all cases where the starting trench should happen to be the first-line trench, the complete removal of the obstacles protecting it should be provided for during the night preceding the attack.*
[*In cases where the first-line trench is used as a starting trench and it is desired to retain the protection of the accessory works, one or other of the following methods may be used:

n. The construction of a number of underground saps starting from the fire trench and debouching in front of the wire entanglement.
o. The creation of wide breaches in the parapet extended beyond the accessory works, from which the troops will debouch to a flank by means of steps or inclined planes (see figure above [not reproduced]).

Both these methods are, however, merely adventitious.]

The "starting parallel" will be arranged in such a manner as to be capable of containing every description of stores intended for the assaulting troops (ammunition, grenades, wire, sandbags, &c).

All arrangements will be made (in the form of special detachments, tools, and dug-outs) to facilitate repairs under fire of the enemy's artillery.

Numerous communication trenches will be provided between this parallel and the rear, in order to allow of its immediate occupation on the order being given.

To the front, a few "Russian saps" will indicate the line of the new communication trenches which are to join up with the enemy's first-line trench, and are to be constructed after the latter has been taken.

First-line trench.—This will serve as cover for the first units which are to come into action until they enter the "starting parallel." It will be arranged accordingly (with rails, traverses, and dug-outs).

It will therefore have to be evacuated in good time by the garrison, which must be withdrawn to the portions of the trench not required by the attacking troops, in order to avoid confusion.

Points of Assembly.—These will form immediate points of assembly close to the front for successive reinforcements as they come up to support the troops already engaged.

There must be enough of these to provide cover for the whole of the troops liable to be engaged in the course of one day.

They may consist of lengths of trenches capable of containing a platoon or half-platoon, parallel to the front line (see Figs. 2 and 3). They will be covered over or dug underground, and must be proof against the smaller type of shell; they must be arranged so as to allow sufficient rest for the troops; their organization will be completed by the provision of a water supply and latrines.

The average distance separating them from the starting parallel will be short, as the zone behind the first line usually suffers more from the enemy's artillery than the first line itself; at the same time it is advisable to reduce the distance by which they are separated from the front in order to ensure the rapid entry of the reinforcements into the line.

Communication trenches.—The communication trenches will provide artificial routes under cover by means of which the firing line can be supplied with men, ammunition and rations, and the evacuation of casualties can be secured throughout.

Towards the front they will be narrow but numerous. To the rear, where they must be of a width allowing the passage of two men abreast, their number will be reduced; it must, however, provide liberal means for supplying fortified points with fresh troops.

All movements in the communication trenches will be carefully organized and controlled. Movement will be allowed in one direction only, some of them being reserved for the evacuation of casualties; moreover, their width will be enlarged at certain points, in order to provide for unexpected complications. No halts will be allowed; on the same principle, the rule that all casualties are to be immediately evacuated to the rear of the scene of the attack must be strictly applied.

The communication trenches will be provided with sign-boards and guide posts; care will be taken, in their construction, to avoid crossings which may hamper the movement of troops and lead to loss of direction.

The upkeep of communication trenches will be the subject of special arrangements; it may devolve on working parties (Territorial Reservists), whose duty it will also be to enforce the orders issued with regard to their use.

The communication trenches will be extended as the attack progresses. Those intended to link up the enemy's first-line trenches will be commenced before the attack, continued during the action, and must be completed as quickly as possible on account of the walls of fire created by the enemy's artillery.

Observing stations and telephonic communication.

The preparation of the ground will include observing stations for the commanders directing the attack as well as for the artillery observers. These observing stations, whether above or below the surface, must be proof against bombardments; if underground, they must be provided with suitable periscopes.

It is desirable that they should be close to the communication trenches with a view to assisting the work of liaison officers.

The system of telephone lines which radiate therefrom should be laid along the drainage-channels, which run along the side of the communication trenches, so as to be under cover and easily repaired under fire; it will be advisable to double and even treble them. They must also be supplemented by means of visual communication (signalling apparatus).

The works required for producing on the area of the attack an organization fulfilling the conditions examined above are of the highest importance.

They must be carried out at leisure, well in advance of the attack.

Those works, however, which are nearest to the front (starting parallel, advanced communication trenches) will only be executed immediately previous to the assault and by night in order to avoid prematurely drawing the enemy's attention to the scene of the attack.

Example of the preparation of ground to be attacked.—For the sake of example, the preparation of ground on a front of 1,200 yards, selected for attack by a division, will be studied (Fig. 3).

The starting parallel, 1 yard in width, will be occupied at the moment of the attack by the 6 leading companies of the leading regiment.

The first-line trench, which must serve as cover for these companies, will be linked up with the starting parallel by 24 communication trenches (1 per section) 1 yard in width.

The points of assembly in the first line, situated 50 yards in rear of the first-line trench, will be arranged for occupation by the 6 remaining companies of the leading regiment, and will be linked up with the first-line trench by means of 12 communication trenches (2 per company), 1 yard in width.

100 yards further to the rear will be found the assembly points of the second line, capable of containing 6 companies of the second regiment: they will be joined to the former assembly points by 6 communication trenches 2 yards in width, debouching both in front and to the rear into lateral communication trenches parallel to the front.

Four communication trenches will lead up to the edge of the area of the attack.

At the same time, two communication trenches reserved solely for the evacuation of casualties will run from one end to the other, terminating in dressing stations situated on the outskirts of the area of the attack.

The remainder of the division (two and a half regiments) will be formed up at the entrance of the communication trenches, in shelters or in bivouac, ready to move up along the communication trenches or across country.

To sum up—

One brigade, with greater part of its effectives (18 companies), in immediate proximity to the attacking front is ready to come into action.

The other brigade is immediately in rear of the first, ready to follow it

8: CDS 50, Tactical Notes, July 1915

Source: IWM SS/CDS Pamphlet Collection

CONFIDENTIAL.

[Not to be taken beyond Brigade Headquarters.]

O.B./39

TACTICAL NOTES.

(ISSUED BY THE GENERAL STAFF, G.H.Q.)

1. The following notes have been compiled from reports received from formations which have taken part in recent operations: —

   They contain information with regard to—(i.) the maintenance of communication with the Infantry after it has advanced to the assault; (ii.) methods for dealing with hostile machine guns; (iii.) methods of indicating points reached by our attacking troops; (iv.) methods for reinforcing the front line; (v.) some miscellaneous questions.

2. *Maintenance of communication with the Infantry after it has advanced to the assault.—Telephones.*—Between the front line trenches and Divisional and Brigade Headquarters telephone lines must be in triplicate, or even in quadruplicate, and one line should be buried; "ladders" at frequent intervals are also necessary.

   Beyond the "departure" trench, it has been found possible to run out telephone lines. They are either taken forward with the first advancing troops, or are run out quickly during pauses in the enemy's fire; but they are liable to constant damage by hostile artillery.

   The telephone cannot, therefore, be relied on after the Infantry has advanced. It has, however, so many advantages over other means of communication that every effort should be made to lay the lines and keep them in repair.

   Other methods for maintaining communication are given below.

3. *Orderlies.*—This form of communication is the most used, and though it is slow and requires a considerable expenditure of personnel, it has proved in the end to be the most reliable.

   In some formations, officers have been used for this purpose. One officer is detailed by each battalion and is charged with the duty of maintaining communication between Brigade Headquarters and his unit; he should be accompanied by an orderly.

   It may sometimes be possible for these officers to transmit information back to Brigade Headquarters, after they have reached their unit, by means of the telephone used by the

Artillery forward observing officers.

More generally, however, "runners" have been used, each message being sent by at least two independent "runners." The men are specially selected; a suitable distribution is four per company with six at battalion headquarters. "Runners" have also been used to form a chain of communicating files along a marked feature (trench, hedge, pathway, &c.), messages being passed along the chain.

It is most important to connect our line by some sort of communicating trench with the enemy's front line as soon as the latter has been captured. Even if this is only a foot or two deep, orderlies can crawl to and fro. Parties should be told off to continue the saps previously run out towards the enemy's line as soon as the assault is delivered, and other parties should also be told off to work backwards from the captured trench to meet them.

4. *Visual signalling.*—Semaphore, Dietz discs, lamps, helio and flag have all been used at various times. The great difficulty has been to avoid observation by the enemy, especially in flat country, though this can sometimes be overcome by the use of ruined houses, haystacks, trees, &c.

Good results have been obtained from visual signalling in the more advanced portions of the line by sending from front to rear only, each message being repeated three times without acknowledgement or reply from the receiving station.

The Siemens' improved electric signalling lamp has on the whole proved the most efficacious apparatus for the above purpose both by day and by night.

5. *Method of dealing with hostile machine guns.*—The difficulties [words missing where document is torn]
   i. How to locate the guns.
   ii. How to dispose of them whenŠ [words missing where document is torn]

German machine guns are often placed in one of the following positions:—

- c. In a very thick advanced traverse, firing so as to flank the main parapet.
- d. At a trench junction
- e. Dug in, very low in the parapet itself.
- f. In cellars.
- g. Dug in, in front of ruined houses.

The difficulty of locating guns in such positions is obvious, nor is it easy to draw their fire beforehand, as they are often kept hidden, and only moved up into position when an attack is imminent.

6. Careful and continuous observation is the best means of locating the emplacements. A heavy bombardment on the first line and support trenches, both on

the front of attack and on the flanks, appears to offer the best chance of destroying the guns; while a barrage of H.E. shell on both flanks of the Infantry attack, directed on the enemy's trenches and tactical points in rear, will probably neutralise their fire.

The following methods of dealing with them have also been found successful at different times:—

(a.) By rifle or machine gun fire concentrated on the emplacement, if it has been located. This is reported to be quicker and more effective than shrapnel.

(b.) By trench mortars and rifle grenades, fire being concentrated on likely places. In one instance 14 trench mortars were concentrated against suspected machine gun positions and none came into action in that part of the line.

7. *Method of indicating positions reached by our troops.*—The following methods have been used:—

By day—

. Coloured screens about 3 feet by 2 feet, on two poles 4 feet 6 inches long, the side facing the enemy being covered with inconspicuous green material. These were found of great value to the Artillery observing officers.
a. Flags or discs on 9 or 10-foot poles. These poles were unnecessarily long and cumbersome
b. Sides of biscuit tins placed behind the trenches or houses captured by our troops so as to be visible from the rear.
c. Strips of white material laid down on the ground for identification by aircraft. Unless some such method is employed aircraft cannot distinguish between our own and the enemy's troops.

The drawbacks to all the above are that if the position has to be evacuated the signal may be left behind and so become misleading; moreover, if captured, it discloses our arrangements to the enemy. The design of the screen, flag or disc, also must be changed on each occasion.

d. Placing caps on rifles and holding them above the trench. This has been very generally used.
e. Daylight fireworks. These are reported to have been effective.

By night —

f. Coloured rockets and Very's pistol lights, the colours or combination of colours being changed for each operation.

The Germans, however, are in the habit of sending up rockets as soon as an attack starts in order to create confusion.

8. *Movement of supports to reinforce the front line.*—It has been found that troops detailed for the assault must be formed in considerable depth, and that trenches with good splinter-proof cover are necessary for this assembly. These trenches should be prepared in successive lines according to the cover from view obtainable. A suitable distance between lines has been found to be from 40 to 50 yards.

Plenty of efficient communication trenches must be dug to connect these lines from [words missing where document is torn] Š[in]tervals of not more than 50 or 60 yards apart, so that troops may [words missing where document is torn] least possible loss and delay.

Communication trenches must be told as "up" and "down" trenches and picketed to ensure that they are only used in one direction only.

Sidings off these trenches are essential.

At intervals there should be communication trenches wide enough to admit of the evacuation of wounded men.

Any attempt to crowd troops into a confined space, in immediate proximity to the front line, leads to heavier casualties than an advance from lines in rear.

Experience has shown that once an attack is checked it is seldom helped forward by supporting troops pushed up directly behind it. The desired result is more likely to be obtained by pushing on on the flanks of the troops which have been checked, or else by a bombardment of the hostile positions in front of them.

9. *The following points are also brought to notice:—*

. Our own wire can be removed during the period of heavy bombardment; it must have been previously prepared the night before. It is advisable that the removal of the wire should take place as late as possible, in order that the enemy may not receive warning of the impending attack.

a. Artillery barrages should be directed on to the enemy's supporting points and communications, and not on open spaces of ground, which leads to waste of ammunition.

   Should the enemy be seen to start forming up to deliver counter-attacks, it is desirable to allow him to do so; once formed up he can be heavily punished.

b. Reports have been received that the flashing of bayonets over the tops of forming-up trenches or parapets discloses the position of the Infantry assembled to attack. This should be guarded against.

c. he organization of grenadier parties, particularly as regards the bringing up of reserves of grenades as the attack progresses, is most important.

d. Above all, it is important to vary the methods employed each time an attack is delivered. This applies particularly to artillery bombardments.

G.H.Q.,
31st July, 1915

9: CDS 93, Report on Experimental Firing with 18-pr. Shrapnel and H.E. at Calais, November 1915

Source: IWM SS/CDS Pamphlet collection
(Issued by the General Staff at General Headquarters) November, 1915

Description of the Experimental Firing.

The trials were carried out on the sands just east of Calais over the ground used by the French for their own artillery experimental firing.

The ground was somewhat unsuitable for the erection of wire entanglements as there was only the sand available, and in some parts it was damp.

The battery consisted of four guns in position amongst the sand dunes with the trails supported on sandbags. The gun platforms, therefore, though only indifferent were not sufficiently so to affect the shooting adversely.

Targets.—The targets consisted each of two rows of wire entanglement, separated by a space of 10 yards, each row being 20 feet deep. Ten yards in rear of the second row was a parapet built up of sandbags 4 feet 6 inches high in the centre and 3 feet at the ends and about 10 feet thick: Targets 1, 2, 4 and 5 had a parados behind the parapet. Targets 3 and 6 were open at the back. The frontage of each target was 20 yards.

There were three targets arranged side by side at each of two ranges, namely, 2,700 yards and 3,400 yards.

Series.—The number of series fired was six :—

1. Time shrapnel	Range, 2,700
2. H.E. burst on impact	"
3. H.E. with delay action fuze	"
4. Time shrapnel	Range, 3,409
5. H.E. burst on impact	"
6. H.E. with delay action fuze	"

During the first three series fire was stopped in each case after 60 rounds for the purpose of examining the targets. Fire was then continued up to 120 rounds for each series, except in Series 3, in which fire was not continued after 60 rounds.

For the 4th, 5th and 6th series 150 rounds each were allowed and no pause was made for examination of the targets.

Effect on Targets.

Series l.— After the first 60 rounds a few posts were broken and strands of wire cut, but there was no practical diminution of the obstacle as a whole.

After the series was completed there was a narrow path through the front strip of wire about 2 yards wide and through the rear strip about 5 yards in width.

Six sandbags were thrown down into the trench. About 50 per cent. of the rounds burst on graze. The principal damage to the entanglements appeared to be caused in each case by a well pitched percussion shrapnel.

Series 2.—In the first 60 rounds there was practically no effect obtained.

After completion of the series there were some six or eight posts broken and a few strands of wire cut, but no important damage done; as a wire cutting series it was a failure.

There were four detonations in the first entanglement.

There were three detonations in the second entanglement.

There were four explosions in the second entanglement.

There were four sandbags blown down into the trench.

Series 3.—As in Series 2, except that there was practically no effect against the wire, which was almost untouched.

Twenty-five rounds burst on graze; 35 burst after graze at an average height of 14.5 feet.

Eleven hits on a canvas screen stretched on the ground behind the parapet. 11 sandbags knocked down from the parapet. No hits on some boxes placed close under the parapet.

Series 4.— No pathway was made through the wire and very little of the entanglement was in any way disturbed.

Many of the shell were burst at a suitable height just short of the target. The shooting was in no respect erratic, but the guns might have shot better together.

Series 5.—The entanglement was undamaged by the fire.

Eleven sandbags were knocked down into the trench.

Seven shell had detonated and 7 exploded in the first entanglement.

One shell had detonated and 5 exploded in the second entanglement.

Series 6.—The entanglement was undamaged by the fire.

Thirty-five per cent. burst on graze.

Fifty-eight per cent. burst after ricochet at an average height of 16.1 feet.

Eight per cent. were blind.

Three of the boxes placed behind the parapet were perforated by splinters.

The boxes were not so close to the parapet as in Series 3.

There were 35 hits on the canvas on the ground behind the parapet.

Eight sandbags were knocked down from the parapet.

One shell had detonated and six had ricochetted in the first entanglement, and seven shell had ricochetted in the second entanglement, but no shell had detonated in the wire.

About 75 per cent. of the H.E. were filled Amatol and 25 per cent. with. Trotyl.

The blinds amounted to about 5 per cent. of the whole of those that burst.

With Trotyl.
76 per cent. completely detonated.
24 per cent. partially detonated.

With Amatol.
16 per cent. completely detonated.
46 per cent. partially detonated.
38 per cent. exploded only.

No. 85 Fuze.
The blinds amounted to about 6 per cent. of the whole of those that burst.

With Trotyl.
77 per cent. completely detonated.
23 per cent. partially detonated.

With Amatol.
8 per cent. completely detonated.
36 per cent. partially detonated.
56 per cent. exploded only.

Objects of the Experiment

The principal objects in view were—

1. To compare the effect of 18-pr. shrapnel and H.E. burst on impact against ordinary field entrenchments protected by wire entanglements.
2. To demonstrate the effect of 18-pr. H.E. with No. 100 fuze and gaine with delay.

Conclusions.

As regards the first of these objects, the experiment conclusively proved the superiority of the 18-pr. shrapnel over H.E. burst on percussion for cutting wire.

It also showed that the H.E. overs that missed the wire and insufficient effect on the parapet to make it worth while to use H.E. for wire cutting with the subsidiary object of damaging the parapet at the same time. It is clear that damage to defences of any strength can only be obtained with 18-pr. H.E. by an accurately ranged and concentrated fire.

The greatest effect produced on the wire was by percussion shrapnel, and it is not unreasonable to infer that the best effect may often be produced by choosing a corrector that will give from 50 to 75 per cent. of grazes. It was clear also that the effect on the wire varies considerably with the range. It is, therefore, not possible to lay down that wire can be cut with so many rounds per yard.

There are other factors that come in, such as the strength and extent of the obstacle, the contour of the ground, the facilities for observation, the skill of the Battery Commander and the service of the guns. It is perhaps safe to say that if the range is over 2,500 yards a considerable increase in the amount of ammunition will be necessary, and it should be a rule that if it is intended to follow up the wire-cutting by an attack the fire should be con-tinued till the object has been satisfactorily attained.

Ammunition will be saved if each gun is carefully ranged before opening fire for effect.

The experiment was not intended to demonstrate the value of any particular method of fire for wire-cutting, and nothing of value was learnt in this respect.

As regards the second object, the general impression gained of the H.E. with No. 100 fuze and gaine with delay was fairly satis-factory, but allowing for the fact that some of the shell were caught by the parapet and some in the rough sandhills beyond, the percentage that burst after ricochet was not as high as had been expected. The number of hits on the boxes and canvas showed the downward effect of the burst. Shrapnel bullets could not have reached either the boxes or the canvas, and it is a fair con-clusion that this projectile is more effective against infantry in trenches, and therefore preferable to shrapnel for retaliation, and on any occasion when infantry can be compelled to man their parapets.

The impression was also gained that this projectile would be effective if mixed with shrapnel for repelling an attack or for barrages.

The superiority of Trotyl over Amatol was most marked, at any rate with the present method of detonation.

A note is attached on the comparative value of H.E. burst in the air with time fuze and burst in the air after ricochet, but this question was not tested at the experiments.

Equipment Details.

72nd Battery, R.F.A.

Ranges.

Map range	2,800 yards.	Gun range	2,725 yards.	
		" 3,5000		" 3,375-3,400 yds.

Guns
No. 1.—R.G.F., 1905. No. 698.
No. 2.—C. L. & Co., 1905. No. 161.
No. 3.—C. L. & Co., 1905. No. 148.
No. 4.—E.O.C., 1905. No. 245.

Probably these guns have all fired some 6,000 rounds each previously.

Shell with No. 85 fuzes.
Cordite M.D. ; size 8. Lot H.P.C. 6 A.C. W. 28.9.15.
Fuzes, B.S.C. : various lots including 306 and 312.

Shell with No. 100 fuzes.
Cordite M.D. ; size 8. Lot H.P.C. 6 A.C. W. 26.9.15.
Fuzes, No. 100, Mark I. Lots E.L. 1, 11, 12, 13, 15, 122 and various others.

Shrapnel shell Mark V.
Fuzes, E.O.C., dated 6/15. Various lots 210 and 218.

NOTE ON THE USE OF HIGH EXPLOSIVE SHELL FOE FIELD GUNS.
(The comparative value of H.E. with time and ricochet fuzes.)

H.E. shell for 13-pr. and 18-pr. guns may be used in three different ways :—

3. With a T. and P. fuze (No. 80 or No. 85) set to burst in air.
4. With a percussion fuze or T. and P. fuze set to burst on impact only.
5. With a delay action fuze, which will cause the shell to burst in air after graze.

H.E. shell will eventually be issued to batteries at the rate of 50 per cent. of the whole equipment. Of this number about one-half will be fuzed with No. 100 fuze with .04 second delay, and one-half with a T. and P. fuze.

It is of great importance that officers who have to use this ammunition, and who have not had much experience in testing the comparative effect of the different kinds of fuzes, should be well acquainted with their possibilities, in order to be able to suit both the nature of ammunition and the method of its use to the occasion.

The value and use of shrapnel are well known. A hard hitting heavy shrapnel shell depends for its effect on its forward sweep. The shrapnel is, therefore, always burst in front of or short of the objective.

With H.E. the case is different. The forward effect is practically nil. The force of detonation acts in a radial direction at right angles to the longer axis of the shell. The forward sweep is entirely absent. If burst in the air the shell must burst over the target to be struck. If the shell were, horizontal it would need to be vertically over the objective. If the shell is falling, and therefore with its longer axis inclined downwards, the effect will be partly backward, as with the German H.E. shell with a time fuze. If the shell is rising at the moment of burst as with a ricochet similar to the French, the effect is slightly in a forward direction. This radial action of the wave or force of detonation is known as the cart-wheel effect, and is common to all H.E. shell.

As with our equipment we are in a position to obtain bursts not only on percussion but in air, either with a time fuze or with a ricochet fuze, the characteristics of the two methods of obtaining air bursts are worth consideration :—

With delay action fuse.—There are two factors affecting the accuracy of shooting or possibility of bursting the shell in a position suitable for hitting the objective, they are :—

6. The error of the gun.
7. The error in the delay action of the fuze.

The Calais trial showed that the latter is very considerable, the bursts taking place at heights varying from about 1 foot to 40 feet, representing a horizontal distance of about 50 yards at a range of 3,000.

Added to this, however, is the error of the gun, and the 100 per cent. zone with the 18-pr. at 3,000 yards is about 120 yards.

It will be seen, therefore, that to obtain hits on men in a trench under cover of the parapet a large number of rounds would have to be fired, for it would be necessary to obtain a burst almost vertically above such a narrow target in order to obtain effect.

A further difficulty in dealing with this nature of fuze is the limitation which is imposed by the nature of the ground in front of the target. The action, of the fuze is dependent both on the surface of the ground and the slope which affects the angle of incidence of the shell. A ploughed field or any rough or boggy ground will add considerably to the number of shells that fail to ricochet, whilst the slope of the ground, if towards the firing point, has the same effect.

Finally, the range also has a direct bearing on the percentage of failures to ricochet that may be expected.

The figures for ordinary firm level grass land are as follows :—

Ranges up to 2,500 yards, ricochets, 100 per cent.
Ranges 2,500 to 3,500 yards, ricochets, about 80 per cent.
Ranges 3,500 to 4,000 yards, ricochets, about 70 per cent.
Ranges 4,500 yards, ricochets, about 50 per cent., but these will be short and irregular.
Ranges 5,000 to 6,000 yards, ricochets, about 10 per cent. and very irregular.
Ranges above 6,000 yards, no ricochets.

The critical point is when the angle of arrival is about 10 degrees.

These favourable conditions, however, are rare, and too much, therefore, must not be expected from fire undertaken with this type of ammunition.

H.E. with a time fuze.—With this nature, the conditions to be fulfilled are very different.

Ability to obtain a burst in the correct position depends mainly on the error of burning of the fuze once the range has been found.

All that is necessary is to range until the mean point of impact passes through the objective, then raise the angle of sight by the amount it is desired to burst above the target (say 5 minutes) and obtain the correct length of fuze by alteration of corrector setting in the usual way.

It will be seen that the error of the gun and inequalities and slope of the ground are factors which do not then count.

The error in burning of the fuze is the only variable directly affecting the result, and as all shell should burst in air, except the necessary percentage on graze, the effect at entrenched infantry is likely to be at least as favourable as in the case of delay action fuzes.

When it is further considered that the range has no effect on the H.E. with time fuze, it is probable that the balance will usually be in favour of the employment of this nature in preference to the delay.

For the purposes of barrage fire or shelling areas, roads, &c., when it is desired to combine H.E. with shrapnel, there is less objection to the characteristics of the ricochet fuze, as its action will then be to cause the shells to be distributed over a certain space in depth, whilst at the same time the cart wheel action is produced at each point of burst in turn.

If used against buildings, the ricochet fuze would burst the shell about 40 or 50 feet in rear of the first part of the building struck, and probably the effect would be lost. A percussion or T. and P. fuze designed to burst on impact with the house would be more suitable

10: Minutes of MGsRA Conference, 24 December 1915

Source: Headlam Papers, RAI, file 183/8

CONFERENCE OF MAJOR GENERALS
R.A. 24th December, 1915.

PRESENT.
Major General Headlam, G.H.Q.
Major General Mercer, First Army.
Major General Franks, Second Army.
Major General Johnson, Third Army.

1. It was decided to keep minutes of the proceedings, and to circulate these to officers attending on the clear understanding that they were for ³domestic consumption² only, carried no official authority and were not to be quoted in any official correspondence. These minutes will be sent out on Tuesday afternoon with any suggestions of subjects for discussion from G.H.Q. Armies will send subjects they suggest on the same day to G.H.Q. and to other Armies.
2. The question of the best means to adopt for incalcating a common doctrine was first discussed. The multiplication of papers on the subject was deprecated, but at the same time it was agreed that the issue of short pamphlets giving the result of the experience gained in different matters, such as for instance, counter-battery work, wire cutting, etc. would be very useful to officers, especially now that such a large number are inexperienced. G.H.Q. will take up the question with General Staff, and, if the idea is approved, will prepare a list of suitable subjects. Armies agreed to assist in the work by preparing the notes on certain subjects. First Army gave particulars of the AIRE COURSE which is doing such valuable work, and Second and Third Armies will consider the possibility of starting something of the same sort.
3. It was agreed that there would be many advantages in defining more closely than at present the duties of the G.O.C. the artillery of a Corps. Armies will consider a draft prepared by G.H.Q. on the subject for next week. (Dropped - see minutes of 31/12 §1)
4. The question of the best means to adopt for the location of hostile batteries was discussed at some length. All were agreed that there was no necessity that the personnel employed should be artillery, in fact, that it would be better to get men from other arms now that it is possible to find men in the Army who understand the use of surveying instruments but there should be a small percentage of artillery to ensure the connection between the system and the artillery being maintained. The First and Third Armies were in favour of placing the whole system under the topographical section; the Second Army would like it under artillery control. It was generally agreed that this was a matter which might well be left to Armies to arrange. (Sent minute to GS to this effect. JH)
5. The recent orders as regards separation of trench mortar batteries into two classes were gone into in some detail. It was generally agreed that the 4-inch was

not an infantry weapon; but, in view of the fact that the actual orders on the subject had been issued by the General Staff it was agreed that nothing could be done beyond devoting the attention of the Trench Mortar Schools to the formation and maintenance of the medium batteries. These Schools will also train instructors for the infantry batteries, but it will be impossible for them to do more than that; and these infantry batteries must be formed in Corps independent of the artillery.

6. The experience of Artillery Schools in Armies has shown the necessity of paying particular attention to the training of young temporary commissioned officers, both in their gunnery duties and in the ordinary duties of an officer. This is the duty of Brigade Commanders, and Armies will take this up.

7. The question of mixed brigades in Field Artillery, gun and howitzer, was raised, and all officers were unanimously in favour of this. G.H.Q. to take up.

8. Attention was drawn to the necessity for arranging that all the 18-pdrs. do not wear out at the same time. G.H.Q. to take up.

9. The allotment of new batteries--one 12" Howitzer and one 4.7"--shortly expected was discussed. It was decided that it was better to get 12" howitzer batteries together, and, in order to do this, First Army are willing to let their howitzer of the 18th battery join the other of the same battery in the Second Army, and to take themselves the new battery. (Done)

10. Major Livingstone Learmonth, D.A.A.G. attended, and discussed the following questions connected with the Adjutant General¹s branch:-

    i. The proposal to attach partially trained men in addition to establishment. It was agreed that this was only required in the case of the heavy siege, e.g. 6" guns and upwards, 8" howitzers and upwards; that 20 per battery would be a convenient number, and that if these were allowed we would be prepared to receive partially trained drafts.

    ii. The question of sending home three Lt.Colonels to train brigades at home. It was agreed that the best course would be to send the three seniors who have completed their 5 years as Lt.Colonels, and have not been appointed to command the artillery of a division.

    iii. The necessity of careful selection when recommending Temporary Lieutenants for promotion to Temporary Captain. Men of the world, of 25, or so, and upwards, with the power of command and of handling men are what are required.

    iv. Similarly, great care to be taken in selecting officers with temporary commissions for permanent commissions. Out of the five, it should be normally three Field and two Garrison, but this need not be rigidly adhered to; the great thing is to get the best men.

11. A list of officers elegible for the higher artillery commands was gone through. The principle to be followed in recommending officers for Brigade Majors was also discussed. The general opinion was that it was generally inadvisable to take a Major for Brigade Major who had had no previous staff experience of any sort. (Cancelled in minute of 31/12)

11: SS98/4, Artillery Notes Number 4, Artillery in Offensive Operations, April 1916

Source: IWM SS/CDS Pamphlets collection

This note is supplementary to that on "Preparatory measures to be taken by Armies and Corps before undertaking offensive operations on a large scale."
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I. The General Plan of Attack

1. Duty of the Artillery Commander.

In all offensive operations it is the duty of the officer commanding the artillery of the force engaged, whether this is an infantry brigade with artillery attached, a division, a corps, or an army, to prepare an "artillery plan" as described in this paper. This plan will be based on, and supplementary to, the general plan of attack.

2. Selection of the front of attack.

Under present conditions, no offensive operation can be expected to achieve complete success unless both the preparation and support by the artillery are effective; and for this it is not enough that the requirements in guns and ammunition should have been correctly estimated and adequately provided. The first and most essential element of success is that the front selected for attack should admit of a full development of artillery fire, and of complete co-operation between the artillery and the infantry. It is only when the ground allows of artillery commanders—

i. Seeing clearly the enemy's defences, and also following the movements of the attacking infantry;
ii. Controlling the fire of their guns rapidly and effectively; that the infantry can count on obtaining the full measure of support which artillery can render. For, however carefully thought out the arrangements for the control of both artillery fire and infantry movement may be, they are always liable to be thrown out of gear by some unexpected development.

It is, then, the first duty of the artillery commander to place before the general officer commanding the force full particulars as to how the ground affects the efficiency of the artillery preparation and support, so that the latter may give due weight to such considerations in selecting the front of attack. "An objective which may appear at first sight easy of access to the infantry, may prove in the end costly to attack, if it does not lend itself to the judicious application of artillery fire; and vice versa, localities which present difficulties to the infantry alone may, if it is possible to bring the converging fire of artillery to bear on them, be carried with comparatively little loss."

3. Estimate of guns and ammunition required.

The general plan of attack having been settled, it is the next duty of the artillery commander to prepare an estimate of the amount of artillery and of ammunition required for the operation. The first point to remember is that the *ammunition* required depends upon the work to be done, *i.e.*, upon the enemy's defences, more than on the number of guns available. The latter is, however, the governing factor as regards the *time* which will be required for the preparation, and has therefore an important bearing on the general plan of attack, for if surprise forms any part of the latter, it is essential that sufficient *fire units* should be available to allow of the different portions of the enemy's defences being bombarded simultaneously.

The *nature of guns* required depends, like the ammunition, on the nature of the enemy's defences. There has sometimes been a tendency to think that nothing but the heaviest howitzers should be demanded on all occasions. A little consideration shows that even if the number of these natures available, and still more the amount of ammunition for them, were unlimited—conditions which are never likely to be fulfilled—questions connected with the supply of ammunition alone would necessitate economy in their use. In estimating requirements the heavier natures should only be detailed for tasks beyond the power of the lighter.

4. Reconnaissance.

An estimate of the guns and ammunition required can, therefore, only be made after thorough reconnaissance of the enemy's system of defence, including his trenches, machine-gun emplacements, observing stations, communication trenches, rear lines, strong points, wire, &c. This reconnaissance must include not only the examination of the ground from all possible points of view, but also the reports of air observers, and a very careful study of air photographs, and of all information available in the intelligence section. The latter should give the roads used by the enemy in bringing up reinforcements and supplies of ammunition and food, the places where they can best be blocked by artillery fire, and the forming-up places likely to be used for counter-attack. The number and nature of the guns which may be brought into play by the enemy is also an important factor, as it governs the requirements for counter-battery work.* It is important that the artillery commander should make this reconnaissance in company with the general staff of the formation, and that the fullest information regarding not only the enemy's defences but his habits should be obtained from both the artillery and the infantry holding the front.
[* Counter-battery work has been dealt with in a separate note. (No. 3 of this series).]

II. The Artillery Plan.

5. Scope of the artillery plan.

The general plan of attack having been settled, and information having been received that the necessary guns and ammunition will be available for the operation, the artillery commander will make out his "Artillery Plan." This should be a comprehensive statement of the objects to be attained by the artillery, and the methods to be employed. It will give the organization of the artillery for the attack, the tasks and zones of the various commands, the arrangements for communications and for the co-operation of the Royal Flying Corps, the orders regarding the expenditure and supply of ammunition, and any other points regarding the action of the artillery which it is necessary to include. Its preparation will involve a consideration of all the various tasks of the artillery during the preparation and support of the attack, but care must be taken to avoid cramping the initiative of the subordinate artillery commanders by entering into details which are within their province.

6. Organization.

The organization of the artillery forms perhaps the most important part of the artillery plan. The principle that a divisional commander, to whom a definite objective is assigned, should have under his orders the artillery which is necessary to enable him to carry out his task, may often be inapplicable, as for instance where a corps attacks in depth and divisions succeed each other on the same front; for experience shows that any attempt to apply this principle of attack in depth to the artillery is foredoomed to failure. Now, more than ever, the guns form the "iron framework of the battle"; and all recent operations have proved the necessity for a carefully elaborated scheme for the employment of the whole of the artillery, involving a methodical allotment of tasks from the outset, and depending for its successful execution on an effective chain of artillery command.

7. Allotment of tasks. The number and variety of the tasks which the artillery is called upon to perform necessitate very careful arrangement, if the different natures are to be employed to the fullest advantage. These tasks depend upon the enemy's defences, and must, therefore, vary with the nature and extent of these. The following principles will, however, generally apply.

iii. The first task of the *field guns* is to cut the wire. During the preliminary bombardment they will also assist in destroying the enemy's defences wherever the nature of these renders them vulnerable to the high explosive shell of field guns, as, for instance, where they consist of breastworks. During this period, however, they will be chiefly employed in preventing the enemy repairing their wire, or the damage to their entrenchments. On the day of the attack they will cover the assault by their fire on the front of attack, as well as on the flanks; they will search the communication trenches; and will establish barrages to isolate the attack and stop any attempts at counter-attack.

iv. *The field howitzers* will be used for the destruction of the enemy's first line defences wherever this is within their power, and especially for blocking their communication trenches, both during the preliminary bombardment and on the day of attack.

Both field guns and howitzers will also be allotted to counter-battery work as described in the note on that subject (No. 3 of this series); and the introduction of gas shells for the latter (see Section VI) may be expected to considerably enhance their value for this work.

v. *The medium guns* (4.7-inch and 60-pr.) will be chiefly employed in counter-battery work, but may, in addition, be used for the bombardment of definite points in the enemy's defences, and for sweeping the more distant communication trenches and approaches generally with shrapnel. On the day of attack they will, however, probably be all required for counter-battery work.

vi. *The medium howitzers* (6-inch) have in the past been generally required to assist the divisional artillery in the destruction of the enemy's first line defences. The longer range of the new pattern (26-cwt.) howitzers has, however, greatly extended their sphere of usefulness.

vii. *The heavy howitzers* (8-inch and 9.2-inch) will be chiefly used for the destruction of the enemy's second line defences, and for specially strong points in the first line. During the preparatory period they will also assist in the counter-battery work by destroying such of the enemy's batteries as have been accurately located.

viii. *The heavy guns* (6-inch) will be used, both in the preliminary bombardment and on the day of attack, in sweeping distant approaches, bombarding headquarters, billets, &c., and in keeping the enemy's balloons at a distance. They will also be used to assist in the counter-battery work.

ix. *The very heavy howitzers* (12-inch and 15-inch), and the guns and howitzers *on railway mountings,* will be used for the bombardment of special points of tactical importance, or localities where it is known that there are very strong underground refuges requiring the heaviest shell for penetration.

8. Command.

Although, normally, divisional artillery will remain as heretofore, both tactically and administratively, under the orders of the divisional commander, the scheme of an attack may render it advisable for the corps commander to place the general officer commanding the artillery of the corps in executive command of the whole of the artillery supporting the attack.

In such cases the divisional artilleries will still remain under their artillery commanders, and there will rarely be any reason to interfere with their organization. During the ordinary work of "holding the line" it is often very convenient to substitute "groups" of various sizes, formed to fit the local circumstances, for the established brigades, and this may in many cases be advisable, although it has sometimes been carried to an extreme not warranted by circumstances. It must, however, be remembered that there is an inherent weakness in all such improvised organizations, and that this will probably not be apparent until the unforeseen occurs (as in offensive operations it inevitably will), and the necessity for unrehearsed action arises.

The guns and howitzers allotted to counter-battery work will form a separate command as described in the note on the subject (No. 3 of this series).

The medium howitzers when employed in the destruction of first line defences have usually been placed under divisional artillery commanders, but the increased range of the newer pattern may render it advisable to group them with the heavier natures which will normally form a separate command.

As regards the heaviest natures, and all on railway mountings, the small number available and the fact that the special tasks to which they will usually be allotted are only indirectly affected by the fluctuations of the fight, will often render it inadvisable to restrict their action in accordance with the narrow front of a corps. In such cases they may be retained under the direct control of the Major-General, Royal Artillery, of the army. When, however, they are used to supplement the work of the lighter natures, as for instance when 6-inch guns are used for counter-battery work, or when the 12-inch and 15-inch howitzers are employed to destroy extra strong points in the enemy's trench system, or to bombard villages close behind the line, they should usually be combined in the same command as the other guns or howitzers employed on the same task.

9. Co-ordination.

An important part of the artillery plan is the co-ordination of the different artillery commands. In a corps this will mean the several divisional artilleries and the heavy artillery; in an army the artillery of the different corps, and any heavy artillery which may be retained under the direct control of the Major-General, Royal Artillery, of the army. It will include the measures necessary to ensure co-operation and to avoid any possibility of misunderstanding as to their respective zones and tasks; it will provide for the possibility of bringing heavy concentrations of fire on to particular areas if required; for cases where the heavy artillery of one corps can with advantage engage targets in front of another; and also for the fullest possible use of enfilade fire, the value of which for technical as well as tactical reasons is explained in the note on "Close Shooting in the Field" (No. 1 of this series).

10. Air observation.

Under modern conditions a great deal of the work of the artillery must always depend upon the assistance of the Royal Flying Corps, although the actual requirements will vary according to the extent to which direct observation is possible. It is the duty of the artillery commander to formulate his demands in each case, and to include in his artillery plan the arrangements decided upon: in some cases the arrangement of the guns may be decided by the number of aeroplanes which can operate simultaneously upon the front of attack. It is essential that the observers allotted to artillery work should be placed at the entire disposal of the artillery during the period of registration, as well as for the actual bombardment: close personal touch between observers and battery commanders is the secret of success.

On the actual day of the attack, and during the subsequent days' fighting, the officer directly responsible for the counter-battery work in each corps must have an observer constantly in the air. This will require at least four machines in addition to those required as escort to prevent interference with the air observers by hostile aeroplanes. A machine should also be at the disposal of the general officer commanding the artillery of the corps, ready to go up at once to obtain any special information he may require.

The Kite Balloon Sections will be allotted to artillery commands. The important point to bear in mind in connection with these is that for balloon observation an intimate knowledge of the country is the first element of success. Any change of area should therefore be avoided.

III. The Preliminary Arrangements.

11. Distribution.

A thorough understanding of the work to be done, and of the time at which it is to be done, is essential to the success of the artillery preparation and subsequent action. The work to be done must first be divided amongst the subordinate artillery commands, e.g., in the case of a corps between the different divisional artilleries and the heavy artillery.

These subordinate commanders then allot their tasks and zones to their brigades, and the brigade commanders to their batteries.

Positions will have to be found for the large number of extra guns which will be required for an offensive operation of any size, as well as probably for many of those already in action, whose positions have been selected with a view to defence. Every effort should be made to place the artillery supporting the attack as far forward as possible, so as avoid any unnecessary changes of position during the course of operations, since these must always involve difficulties in connection with registration and ammunition supply. Every precaution must be taken to conceal the fact that new positions are being prepared.

The allotment of observing stations will generally be found a still more difficult problem for the expansion required will be very great and fresh stations cannot be found in a hurry. The importance of a systematic selection and preparation of observing stations cannot be exaggerated.

12. Reconnaissance.

All the above require a very careful reconnaissance both of the enemy's position and of the ground available, and with this object it is of the greatest importance that the various artillery commanders should get into touch at the earliest possible moment with the commanders of the infantry whose attacks they are to prepare and support. Their reconnaissances must be made in conjunction with the infantry officers, and the latter must also examine the ground from the artillery observing stations. And this joint reconnaissance on the ground must be combined with a joint study of air photographs, and of all other information as to the enemy's defences in their common zones of action, as described in paragraph 4. It is only by such means that each arm can get to understand the requirements of the other.

13. Registration.

The value of exact and careful registration before a close and rapid bombardment is obvious. This registration, equally with the reconnaissance, must be carried out in close touch with the infantry as far as it is concerned with the enemy's defences, and this will ensure that the reconnaissance has resulted in a mutual understanding.

The longer the period over which the registration can be spread the better, and in this as in every other way possible artillery commanders must endeavour to avoid giving any indication to the enemy as regards the points of attack. The allotment of observing stations and of aeroplane observers during this period will require very careful attention. It must be remembered that even when direct observation is possible, the assistance of an air observer may often result in considerable saving in ammunition.

14. Protection.*

It is incumbent upon the artillery to take every possible precaution to prevent the enemy's fire from interfering with the execution of the task required of them. This involves making observing stations, battery commanders' posts, telephone dug-outs, and gun emplacements as far as possible shell-proof. During ordinary trench warfare observing parties can usually move if their station is shelled, and detachments can similarly be withdrawn from the guns; and it is therefore often forgotten that such procedure is incompatible with the support of an infantry attack, when the guns must be fought regardless of the enemy's fire. Unless proper protection has been provided for the observers as well as for the guns, the attempt to do so will only result in casualties to personnel and materiel, and consequent failure of the artillery to render the support to which the infantry are entitled.
[* Details regarding the methods of protecting observing stations, gun emplacements, &c., are given in the note on "Artillery holding the line" (No. 7 of this series).]

15. Ammunition Supply.

The arrangements for the supply of ammunition require very careful consideration, for it is of the first importance that nothing should interfere with the movements of the infantry. During the preliminary bombardment there will be considerable traffic connected with the moving up of the infantry, and it is therefore advisable to have the ammunition required for this bombardment with the guns previous to its commencement. But this is not the crux of the problem. The real difficulties will commence on the night after the attack. The roads will then be blocked with reinforcements, ammunition, and supplies going up for the infantry, and with ambulances coming back; and the great object is to avoid adding to the congestion during this period. Every artillery unit should therefore have with it on the morning of the assault, in addition to the full establishment in its echelons, whatever ammunition it is estimated will be spent on that and the following day. It is not necessary that all this ammunition should be actually with the guns,* but it must be so placed that it can be brought up to the guns without interfering with the traffic connected with the support of the infantry. The ammunition so "dumped" must be well protected from fire and weather.
[* It must however be remembered that in the case of heavy artillery the physical strain of working the guns is very severe, and that relief detachments should be able to rest, and not be employed on the heavy work of bringing up ammunition.]

16. Communications.**

Previous to an offensive operation it will be necessary to provide the requisite communications for a much larger force of artillery than will normally be engaged in holding the line, and this requires very careful organization under army and corps supervision. The actual communications to be established in each case must depend upon the organization of the artillery. They will include, in addition to the ordinary framework in the way of command posts and observing stations, the communications required by the higher artillery commanders. These latter will be laid by the signal service, but it is essential that such circuits should be kept quite distinct from the general system. The ordinary telephone exchanges, however useful during trench warfare, are quite unsuited for artillery fighting communications during offensive operations, when all the wires will be in use at the same time.

It is impossible to take too many precautions to avoid the interruption of communication. In addition to protecting the telephone wires as far as this is possible, preparations must be made for the rapid opening of alternative means of communication. Visual signalling is the most important of these, and stations should be selected and established. Possible points in the enemy's lines should also be selected beforehand, so that, after the attack has succeeded, intermediate observers may know where to look for signals. The establishment of central stations from which messages can be sent on by telephone will prove of great assistance.

Short range wireless sets may sometimes be used where visual signalling is impossible, but in such cases reliance will usually have to be placed on orderlies, either on foot or on bicycle. Here, again, arrangements must be made in advance so that everyone may know what to do when the time comes.
[** Details regarding the methods of laying communications are given in the note on "Artillery holding the line" (No. 7 of this series).]

IV. The Preparation of the Attack.

17. Object of the preliminary bombardment.

The preliminary bombardment is designed to achieve a certain purpose, namely, to enable the infantry to enter and penetrate the enemy's position: for this his works and the obstacles protecting them must be adequately destroyed, and his morale shaken. The extent of the ground to be bombarded will depend upon the objective assigned to the attack. It will in all cases include, in addition to the destruction of the enemy's front-line system on the front to be assaulted, the next line in rear, and all communication trenches leading from it towards the front line. Certain areas in rear may, however, be deliberately left untouched, while the communication trenches are heavily bombarded, with the object of inducing the enemy to use this ground for bringing up reinforcements: with the same object it is generally advisable not to shell reserve billets during this period. The trenches, both front-line and support, for several hundred yards to either flank, according to the lie of the ground and the trace of the works, must be dealt with as heavily and effectively as the front of attack itself, and all salients within 1,200 yards from which flanking fire could be brought to bear must receive drastic treatment.

18. Accuracy of fire.*

The proximity of the opposing lines, and the necessity for destroying definite points in the enemy's lines, demand a meticulous accuracy on the part of the artillery never previously contemplated. The various steps necessary to ensure this are detailed in the note on "Close shooting in the field," and in older to allow of attention to these it is advisable to arrange for periodical pauses in the bombardment. During these pauses the fire should be checked by a few rounds on calibration points, equipment carefully inspected, and any slight repairs effected. Such pauses also serve to clear the air for observing officers, besides steadying the nerves of all concerned. They can well be combined with the arrangements for deceiving the enemy referred to in paragraph 22.

But the possibility of danger to our own infantry has also to be considered. The advisability of withdrawing infantry from their trenches during a bombardment depends in each case on the local conditions. If the trenches are good, and *the men do not put their heads up,* they may be safer in the front trenches than crowded in support trenches, which are often heavily shelled directly our bombardment opens—the nearer they are to hostile infantry the safer they are from hostile shells. At the same time the effect of one of our own shell dropping in a crowded trench, or among men creeping forward during the final bombardment, may be disastrous. The "error of the gun" must be realized, and it must be remembered that any attempt to reduce the danger by establishing a "mean point of impact" beyond the objective will seriously diminish the effect of the fire.

The duty of the artillery commander is to make these points clear to the general officer commanding; it is for the latter to decide whether the circumstances justify incurring the risks.
[* See the note on "Close shooting in the field" (No. 1 of this series).]

19. Forward guns.

In some cases guns dug in actually in, or close to, the front line trenches, may prove of great value for special purposes, such as for making a breach in the hostile parapets, or for knocking out machine guns. Provided time is available, experience shows that field guns can be got into almost any position, and that their fire at such short ranges produces a very marked effect. The methods to be employed will vary in every case, but a description of those employed on one occasion, when the conditions were particularly difficult, is given in Appendix B as an illustration of the way in which such a problem should be faced. The secret of success lies in the most careful attention to detail. Unless every possible precaution is taken, the gun and detachment may both be placed hors de combat before they have effected their purpose. Although there is no doubt that their presence has a great moral effect, their use must not be overdone, and they should not open fire until just before the assault.

20. Night firing.

As the bombardment proceeds, it is very important that the enemy should be prevented from repairing the damage done to his trenches and wire entanglements. The duty of keeping these under fire will usually devolve upon the divisional artillery, but the infantry must be called upon to assist with rifle and machine-gun fire, especially at night. Night firing on the enemy's defences may also form part of the programme of bombardment, with the object of shaking his morale; but this will require careful arrangement so as to avoid drawing fire when our own infantry are engaged in reliefs.

Roads and approaches in rear of the enemy's position must, in any case, be subjected to artillery fire at night to prevent the bringing up of ammunition and supplies, and to cause casualties in reliefs. If this is carefully arranged, it may be expected to give important material as well as moral results. In view of the continuous nature of the work required of the artillery by these and other duties, it is essential to arrange that all ranks may get the requisite amount of sleep and rest.

21. Duration of the bombardment.

The *time* required to destroy the obstacles depends upon their nature and extent, upon the number of fire units available, and upon the facilities for observation. If the fire is to be deliberately conducted with accurate observation, so that the full effect can be obtained, the time required can be calculated with considerable accuracy—with the one exception that, where air observation is required, all depends upon the weather. Shortening the period may give the advantage of surprise, and may prevent the enemy bringing up more artillery to meet the attack. On the other hand, it will entail a much heavier expenditure of ammunition of the heavier natures,* and a short bombardment, however intense, may not have the same effect on the enemy's morale as the protracted strain of some days' exposure to constant shell fire, particularly if during this period his communications are adequately blocked. Judging from the duration of the preliminary bombardments in the most important offensive operations during the past year** it cannot be said that the high road to success lies either in a short "hurricane" attack or in a protracted bombardment. The duration and character of the bombardment must primarily depend upon the strength of the enemy's works, and the artillery available for their attack, but many other factors must be considered by the general officer commanding the force, with whom the decision must rest. It is the duty of the artillery commander to place before him the technical considerations involved.

[* Shortening the period will considerably reduce the amount of ammunition—chiefly field artillery—expended on preventing the repair of damaged works, and the bringing up of supplies and ammunition.]

**[See Appendix C.]

22. Character of the bombardment.

Whatever the decision on this point the programme of bombardment must be so arranged as to keep the enemy in uncertainty as to when the actual assault is coming. The German is accustomed to being drilled all his life. If, therefore, it is possible during the preliminary bombardment to drill him until he has become thoroughly accustomed to a certain procedure, and then, when the time comes, to adopt an entirely different one, there will be a very good chance of disorganizing his arrangements. Again, if he can be induced by a burst of intense fire followed by a "lift," to man his parapets, it should be possible to inflict serious losses by judiciously timed shrapnel fire, and by the repetition of such tactics it may be hoped to make him chary of leaving his shelters. Whether when the assault is actually to be delivered it should be preceded by a burst of fire of the greatest possible intensity is a matter on which there has been a gradual change of opinion. Under the present conditions of trench warfare such fire cannot be expected to cause any great effect, and it may just give the enemy the warning which he desires. The most important point is to avoid giving any indication of the intention to assault until the first line trenches have been gained. Generally speaking, therefore, it is better to keep up fire of a medium intensity up to the moment of assault, and then not to make any sudden pause or lift. In some cases success has followed an assault delivered during a period of absolute silence.

23. Progress of the bombardment.

During the preliminary bombardment it is the duty of the artillery commander to watch closely the progress of the work of destruction, and to make any modifications in the allotment of guns and ammunition which he may consider necessary to ensure the completion of the work. To assist him in this, he must arrange for the effect of the fire on the enemy's works to be continually observed by artillery officers and aeroplane observers, and must also be in constant communication with the infantry commanders concerned. A careful comparison of successive aeroplane photographs will be found to afford valuable indications.

In some cases an attack must be launched at a pre-arranged time, whatever the cost, and the responsibility of the artillery commander is then limited to doing his best to have the preparation *as complete as possible* by that time. But when this is not the case, it is the duty of the artillery commander to inform the general officer commanding if he considers the attack should be deferred in order to allow of further artillery preparation. The completeness of such preparation must, however, always be a relative term, and many considerations other than the purely artillery one must influence the decision, for it is a matter which most vitally affects the infantry, and it is one, therefore, on which the opinion of infantry officers must carry great weight.*

While, therefore, it is the duty of the commander of the artillery to keep the general officer commanding informed of the progress of the demolition, and to state whether he considers the attack should be postponed to allow of further bombardment, the decision as to the completion or otherwise of the artillery preparation must rest with the general officer commanding himself.

[* Before the artillery attempt to cut wire, infantry patrols should be sent out to report on the nature and extent of the wire, looking especially for low trip wires where the grass is long. They should also report on the progress of the work of destruction.]

V. The Support of the Attack.

24. Covering the assault.

In trench warfare the arrangements for covering the actual assault are comparatively simple, for, owing to the proximity of the lines, the infantry will in most cases start from within assaulting distance. All that is required is that during the few minutes which will elapse while they are covering the short space between the respective lines, all points in the enemy's defences from which fire can be brought to bear are so smothered with shell as to render this impossible.** This will mean the whole front of the attack, and up to as much as 800 to 1,200 yards to either flank, according to the lie of the ground and the trace of the trenches. It is above all important that any suspected machine-gun emplacements, which have not been absolutely destroyed by the preliminary bombardment, should be subjected to constant fire, for one machine gun unattended to may jeopardize the success of the whole operation.

[** Except when this is purposely omitted in the hope of effecting a complete surprise—vide paragraph 22.]

25. Isolating the attack.

In addition to directly supporting the attack, it is the duty of the artillery to isolate it, and so allow the infantry to consolidate their position undisturbed. For this purpose, after the attack is launched, heavy fire must be kept up on the immediate flanks and on the areas in front. It is particularly important to prevent the enemy's bombers working along the trenches from the flanks, and field guns dug in at close range, as described in paragraph 19, have in some cases proved particularly effective for blocking these. Meanwhile, the fire on the immediate front of attack must be gradually lifted. The "lifts" want careful timing, and should be very gradual, of the nature of a "creep" arranged to suit the pace at which the infantry are likely to make progress. Fire from medium howitzers can of course be kept up after that of the heavier natures, and from field howitzers later still, while that of field guns need not be lifted for a minute or two after the howitzers. Units must be told off to fire off all communication trenches, and other possible lines of approach, and on cross roads, and places where troops might be massed for counter-attack. It is especially important that arrangements should be made to cover the whole front of the new line during the night after the attack. For the second night these may have to be changed according to information obtained from observers and air photographs during the day.

26. Barrages.

The artillery must be prepared to make a barrage right across the front in case the enemy attempts a counter-attack in force, and batteries should be retained "in observation" for this purpose, and not employed on other tasks. Barrage fire must be very carefully regulated, and it must be realized that it is out of the question to keep it up for an indefinite length of time. Where the ground is under observation, it is not necessary to fire until the enemy is actually seen advancing; where the ground cannot be seen from the artillery observing station a slow rate of fire with occasional short rapid bursts at irregular intervals will probably have the desired effect. To attempt to keep up intense fire for any great length of time may only lead to the guns being short of ammunition at the moment when the attack actually comes.

27. Enfilade fire.

Enfilade fire is of particular value in the support of an infantry assault, not only on account of its great effect, but also because of the accuracy with which it can be used. If the guns placed in position for this purpose are anchored and registered accurately on the German front line when at extreme traverse, the fire can be brought back slowly as the infantry assault, by simple turns of the traversing wheel. Guns so placed can also be used to form a "cross-barrage," that is to say, one formed by guns firing at right angles to one another: whatever route is taken in the endeavour to pass through such a barrage, some of the fire must come in from a flank. It must be remembered, however, that enfilade fire must be used with caution in supporting an attack, for if it is extended over ground which the observing officer cannot see, there may be danger of hitting bodies of our own infantry beyond those which the guns are supporting.

28. Advance of the artillery.

If the object of the attack is to reach the enemy's second line, it is necessary that special arrangements should be made for supporting the further movement of the infantry. Where artillery can advance by daylight, guns must be pushed forward for this purpose, supported by the fire of those remaining in action. The units to be pushed forward must be told of it beforehand, so as to allow of their making every possible preparation* for surmounting the difficulties they will meet with. The probable order of advance should also be made out, and the responsibility for commencing the movement clearly defined. Positions and observing stations must be reconnoitred and allotted, and it may sometimes be possible to prepare emplacements, but these must be carefully concealed. Sections or single guns may sometimes be employed in this way when it would be impossible to send forward a complete battery, the section commander being placed under the orders of the commander of the battalion he is supporting.

Field howitzers are especially useful for the close support of the infantry, as they can be placed under cover in positions where field guns could not clear the crest, but it will often be necessary to move forward the medium guns and howitzers of the heavy artillery as well.

Often, however, the country will not allow of guns being moved forward by daylight. In such cases the gains required to support the advance to the second line must be dug in beforehand in or near our front line. If these guns do not open fire until the infantry have reached their first objective, it is quite possible that they will be able to maintain their position.

In the case of a corps attacking on a narrow front, with two divisions in front line and one division in reserve, it would be a suitable arrangement to use the artillery of the reserve division for this purpose. This latter division would then have the support of its own artillery for the attack of the enemy's second line.

[* This will include making exits from positions, improving roads, preparing portable bridges, and arranging for the carriage of the tools and materials required for the preparation of the new positions. For the latter purpose ordinary netting is easily carried and will be found very useful for temporary screens.]

29. Co-operation with the infantry.

The necessity of maintaining the closest possible touch with the infantry throughout the preliminary arrangements and the artillery preparation of the attack has been already insisted upon. In the support of the attack this close co-operation becomes still more essential, and at the same time far more difficult. Information as to the progress of the attack coming through infantry brigade and divisional headquarters will rarely reach artillery commanders in time to be of use. At the same time, to enable the infantry to succeed the continued support of the artillery is required, and this can only be given if the artillery are continually in touch with their progress and can direct fire at once on any points which are impeding their advance.** It is, therefore, incumbent on the artillery to take every possible step to maintain this touch, and the result of experience shows that the following arrangements are generally the most satisfactory.
[** Cases have indeed occurred where the obstacle to advance has been the fire of our own artillery, when owing to the completeness of the artillery preparation the attack has been carried through with a rapidity never contemplated.]

30. Position of artillery commanders.

In the first place the artillery command posts must be carefully selected. Those of the commanders of the artillery of corps and divisions will usually be with the commanders of the formations to which they belong. In cases where a corps commander decides to place the whole of the artillery of the corps under the executive command of the general officer commanding the artillery of the corps, it will be the duty of the latter to maintain the closest touch with the commander of the attacking infantry, and the posts of divisional artillery commanders will be placed where they can best control their commands.

The work of the heavy artillery is so intimately connected with that of the divisional artillery that it is advisable wherever possible to establish the command posts of heavy artillery commanders in the closest proximity to those of divisional artillery. This is also the best way to ensure the heavy artillery commanders being kept informed of the movements of the infantry.

Although field artillery brigade commanders will be in many cases at first with infantry brigadiers, experience shows that any attempt on their part to move forward with the latter only leads to the interruption of their communications with their batteries. Their place is where they can best control the fire of their batteries.

Battery commanders must be where they can best see the general situation. Once the attack has been launched this changes so rapidly that there is often no time to receive orders from higher commanders, and they must be prepared to act instantaneously on their own initiative, of course informing their brigade commander of the action taken.

31. Observing and liaison officers.

Both brigade and battery commanders will require the assistance of "observing officers" and "liaison officers." The primary duty of the former is to observe the fire of their units, of the latter to maintain touch between the infantry and the artillery supporting them, and to call for artillery support as desired by the infantry commander to whom they are attached. Both classes will require their own means of communication, and forward observing officers must be provided with personnel and equipment to allow of their moving their positions.* Artillery brigade commanders will invariably attach a "liaison officer" to the headquarters of any infantry brigade whose attack they are supporting. This officer must be a man of experience and resource.

Each battery commander will usually have a "forward observing officer" to observe the fire from a forward position, to keep him informed of the general situation, and to send back all information possible.

In selecting their position these officers must remember that their business is to assist their battery commanders—not to join in the infantry fight—and that their information is of no use unless they can get it back in time. Their best position will usually be the farthest point forward to which good communication has been opened up; normally battalion headquarters. Probable observing stations in the enemy's lines will also have been previously determined and allotted, and sections from these to points in the second line made from the map to test their field of view, and these will be occupied by forward observing officers as soon as the progress of the attack permits. But as a general rule, by far the best, quickest and most accurate information has been obtained from intermediate observing stations, so placed as to be far enough removed from the turmoil of the attack, and yet sufficiently far forward to command a clear view of the ground over which it is to take place. Where ground allows, one such observing station (at least) should be established by each brigade. As explained in paragraph 2, the possibility of obtaining such observing stations is a point of first importance in forming the original plan of attack.

[*The following has been found a suitable party:—
1 officer: 2 telephones, 2 periscopes
1 non-commissioned officer: 2 small reels of D.1 cable, Visual signalling apparatus, 2 telephonists]

32. Time Table.

Circumstances may, however, necessitate the attack being carried out where facilities for observation are bad; and although various means, such as rockets, flares, flags, &c., have been tried for indicating the progress of the infantry in such cases, none have so far proved entirely successful. It is often, therefore, necessary to have recourse to a "time table," and it is then the duty of the artillery commander to draw this up. No definite rules for this can be given, except that it is necessary always to work to a "zero" which can be changed up to the last moment. An example of a time-table actually used in a recent operation is given in Appendix D, but this must be taken as a guide only, since circumstances will be different in every case. It must always be remembered, too, that the time-table depends on the movements of the infantry, and that whatever care is taken in its preparation it can hardly be expected that their movements will be so regular as to agree throughout with any forecast. A time-table has often worked well during the very early phases after the assault, but the time must come when it can no longer be followed, and all ranks must be prepared for this. It is important that infantry officers should be acquainted with the time-table.

VI. Gas and Smoke.

33. Use of gas and smoke.

Gas and smoke may be used in different ways in an attack. In some cases gas clouds are projected from cylinders, in others smoke and gas bombs may be fired from trench mortars, or gas shells fired by the artillery. Any one of these different methods may be resorted to, or they may be used in combination, but since gas and smoke bombs do not form part of the equipment of the trench mortars manned by the artillery, it is with the gas shells only that the artillery is directly concerned. The use of gas and smoke in other forms, however, may effect the action of the artillery, and must therefore be referred to here. The first point to remember is that owing to the possibility of the use of gas or smoke having to be abandoned at the last moment on account of changes in the weather, no abatement in the thoroughness of the artillery preparation should be made on account of the fact that the use of these aids forms part of the general plan of attack. They will only affect the action of the artillery on the day of attack.

34. Combination of artillery fire with gas or smoke.

The idea that high explosive shell should not be used against those parts of the enemy's line on which a gas attack is directed, for fear of dispersing the gas, may be dismissed. Far from reducing the effect of the gas, shells bursting among it may be expected to increase it by forming eddies which will allow of the gas sinking into the enemy's trenches, dug-outs, &c. There is, therefore, no reason to reduce the H.E. fire of the artillery on account of the use of gas. Shrapnel fire may also be expected to be very effective in combination with smoke and gas, as these will probably cause the enemy to man his parapets, and in some cases to come out into the open.

The use of smoke, however, adds to the difficulties of the attacking artillery, since it interferes with observation of fire, and also of the progress of their infantry. When smoke is used on the front of attack, the artillery must therefore work to a time-table, the disadvantages of which have already been pointed out in para. 32.

As regards effect on the enemy's artillery, it is impossible to interfere with their ability to "barrage" our front line trenches, but the smoke will prevent their knowing the time and point of attack, and therefore will interfere with their power to concentrate upon it. It will also interfere with their power to bring fire on our infantry once they are through the front line barrage, as it will conceal their progress from the enemy's observers.

35. Description of gas shell.

It is, however, in the use of gas shell that the artillery is chiefly concerned. The body of these shells is filled with a chemical liquid (S.K.) which is scattered over the ground as soon as the shell bursts, and then slowly vapourises. The vapour produces intense irritation of the eyes and respiratory organs. It is not poisonous, but those handling the shell, especially in the case of one showing a suspicion of leakage, should be provided with protective goggles, and should at all costs avoid rubbing their eyes with their hands. The bursting charge is only sufficient to open the shell, so that the penetrative effect of the splinters is very much less than with the ordinary shell.

36. Action of gas shell.

The vapour of S.K. is seven times heavier than air, and will therefore remain close to the ground, filling trenches, dug-outs, cellars, covered gun emplacements, woods and hollows. The radius of action of this type of shell depends almost entirely on atmospheric conditions, especially wind. The shells will produce their minimum effect—

- When there is a strong wind blowing.
- During heavy rain (light rain is no serious disadvantage).
- hen the temperature is low, near freezing point.

The most favourable circumstances for use are when there is—

- A total absence of wind, or a light breeze preferably blowing towards the enemy.
- Great humidity of the atmosphere; the more saturated the atmosphere the more marked will be the result.

The effect is particularly marked in valleys, or small woods, and in forests the shells may be employed even when a strong wind is blowing outside.

In the open, on a damp and muggy day with little wind, the effect may last for six hours or more, whereas on a dry clear day, with a breeze, it will probably not persist for more than 30 minutes. In woods, buildings, or covered emplacements, the effect may be felt for as long as 24 hours.

37. Gas barrages.

Gas shells may be employed against a position which it is desired to deny to the enemy for a certain length of time, or to create a barrage through which the enemy's troops cannot pass. To get the best effect it is always advisable to select ground which favours the use of gas, such as for instance a valley, wood, or village. If a gas barrage has to be formed in the open it should have a depth of from 150 to 200 yards. It must always be borne in mind that the fire may have the effect of preventing our own troops from occupying the ground for some hours, or even, in some cases, of traversing it.

38. Counter-battery work.

The chief value of gas shells is, however, for counter-battery work, for which they possess certain decided advantages over the ordinary shell. The gas sinks into the dug-outs; it affects the whole of the personnel; and most important of all, it renders the position untenable for some time. Even if efficient protective masks are available, these will almost certainly considerably interfere with the service of the guns. Moreover, by taking advantage of the wind, effect may be obtained, even if the position of the guns has not been located with the accuracy that is required for obtaining direct hits on gun emplacements; and the effect will be most marked when the guns are concealed in woods, houses, &c., where they are least vulnerable to ordinary attack. Gas shell may also often be used with great advantage against artillery observing stations.

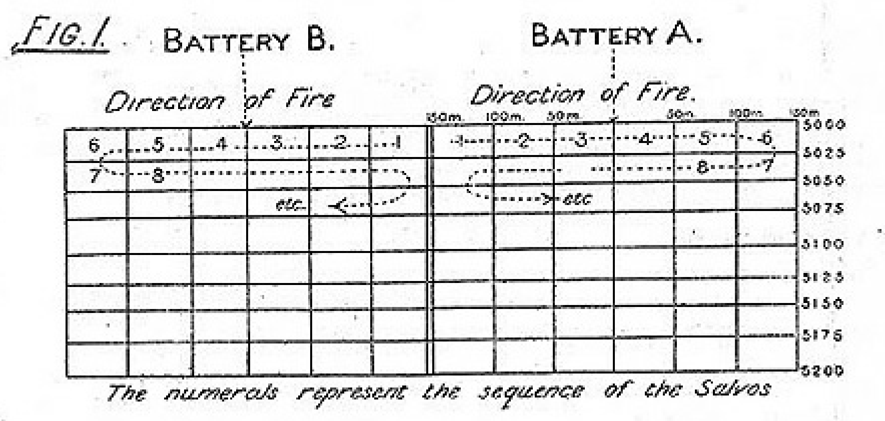
39. Method of using gas shell.

The quantity of vapour of S.K. necessary to produce an effective cloud can only be obtained by firing a large number of shell—with the 4.5-inch, cast-iron shell at least one round for every two yards of front. The fire should be rapid until the necessary cloud has been produced, after which a slow rate will be sufficient to maintain it. Even when the gas shell contain some smoke-producing substance, ranging should be carried out with the ordinary shell, so as to give the enemy no warning of what is coming. To cover a zone really efficiently the fire must be methodically distributed, and the following extract from a captured German document is a good example of how this may be done:—

[extract missing]

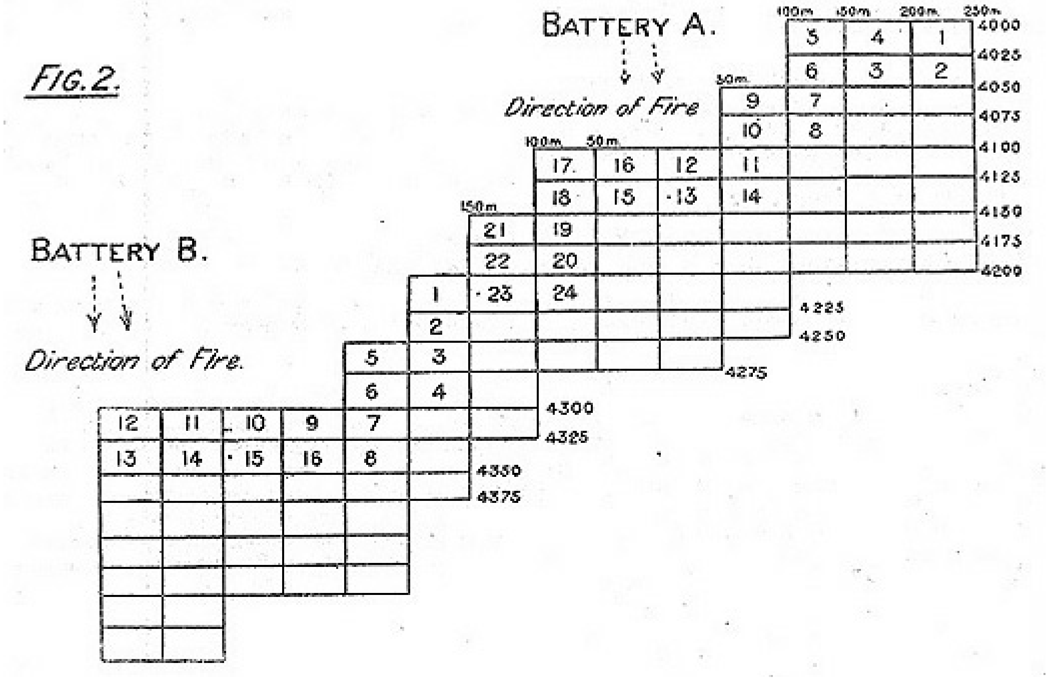
The four guns of a battery are so placed that with parallel lines of fire they will cover a front of 50 metres with their fire. A series of four rounds per 50 metres of front will be fired. The area to be covered is then searched in zones 50 metres wide and 25 metres deep, so that no gaps are left. The barrage should first of all be established along its whole width and the range should not be increased until this has been effected (see Fig. 1).

FIG. 1.



The numerals represent the sequence of the Salvos

FIG. 2.



The sequence in which salvos are fired will depend on the direction of the wind, the nature of the hostile positions included in the area to be shelled, and also on the intentions of our own troops. With a west wind, for instance, the salvos will begin from the west; if our infantry intends to advance later towards the area in question, our salvos will begin on the near edge of the area.

Calculations should be indicated on a diagram, the width and depth of which are proportional to those of the target. Thus Fig. 2 represents a barrage fire against a ravine situated obliquely to the angle of fire. In order to retain control of the fire, even during the procedure of searching, the artillery commander has a similar diagram, which enables him to change rapidly the method of searching in accordance with either his own observations or the reports he receives. He has only to indicate the numbers of the salvos (omit certain salvos or else order a new series at given points).

40. Combination of shrapnel with gas shell.

The combination of shrapnel with gas shell, if judiciously used, may be expected to prove very effective. For instance, if troops concentrated in villages, woods, or assembly trenches are being attacked with gas shells, the ground in rear and on the flanks should be swept with shrapnel at the moment when it may be judged that the gas will have had time to drive them from their cover. The same procedure should usually be followed in counter-battery work.

VII. Conclusion.

41. Counter-battery work, wire cutting, and trench mortars.

In the above little reference has been made to counter-battery work, to wire cutting, or to the use of trench mortars. This is because these are all fully dealt with in separate notes. Nos. 3, 5 and 6 of this series.

42. Conclusion.

In conclusion, it only remains to say that while experience points to the procedure outlined in this note as being the best calculated to secure success, the details will vary with every case. Before forming their "Artillery Plan," on the soundness of which the success or failure of the whole operation may so greatly depend, it is incumbent on artillery commanders, while giving due weight to local circumstances, to consider carefully the principles here laid down for their guidance. But, however complete the plan may be, it is only by the most careful attention on the part of all ranks to every possible detail during preparation, and by the exercise of discipline, self-sacrifice, and a determination to win during execution, that success can be assured.

Appendix A. ESTIMATE OF AMMUNITION REQUIRED.

The following notes will be of assistance to artillery commanders in making their estimates :—

xv. For wire cutting the requirements are given in the note on the subject (No. 5 of this series).

xvi. For the destruction of the enemy's defences, a German memorandum, dated September, 1915, gives the expenditure at:—
1 _ rounds of heavy and medium howitzer;
1 _ rounds of field howitzer;
1 round of trench mortar;
per yard, for an attack on a limited front for the capture of a definite position without a more comprehensive objective. The French estimate is 3 rounds of heavy, howitzer or trench mortar per yard for each line of front attacked.

On 21st to 24th September the First Army fired:—
1 1/3 rounds of heavy and medium howitzer,
2 rounds of field howitzer,
per yard, on a front of 12,000 yards, and an average depth of 1,000 yards. This, however, only enabled strong points to be dealt with and did not admit of a thorough bombardment. At least double would have been required if gas and smoke had not been relied on.

A more accurate estimate is obtained by taking the actual extent of trenches *to be destroyed*(whether first line, support trenches, second line, &c.) and allowing 1/3 round of heavy howitzer and 1 round of medium howitzer, or 2 rounds of medium trench mortar per yard.

xvii. For counter-battery work. The French estimate 400 rounds (heavy) to silence each German battery. We have never been able to make a close estimate of the amount required for counter-battery work, since it depends on the number of the enemy's batteries which may be "active," and the extent of their "activity," and on most of our front it is practically impossible to make any reliable estimate of the number of the enemy's guns. Experience however shows that a very fair approximation to the expenditure will be obtained by allowing 100 rounds per gun per day for all guns allotted to counter-battery work.

xviii. For the miscellaneous tasks of artillery our experience agrees very well with the French estimate of 150 to 200 rounds per gun per day. The following number of rounds can conveniently be fired :—

> Field guns" 200 rounds per gun per day. Field and medium howitzers: 150rounds per gun per day. Heavy howitzers (8-inch and 9.2-inch): 100 rounds per gun per day.

On any one day the number of rounds from field guns and howitzers can be considerably increased.

Appendix B. EXAMPLE OF THE EMPLOYMENT OF AN 18-pr. GUN IN A FRONT LINE TRENCH. Note.

The following is only intended as an example. The particular method employed must vary with circumstances in each case. For instance, on one occasion, where a gun was placed between 150 and 200 yards from the German trenches, an ordinary canvas screen was put up just in front of the position selected. The Germans were allowed to get used to this, and a sandbag emplacement was then built behind it. When the time came for the gun to open fire the screen was not removed but the gun fired through it. In another case it was found when firing a registering round that the gun could not get at the German parapet without hitting our own. No gap in our parapet was however made as this might have invited attention and disclosed the presence of the gun, but on the day of the attack the infantry were cleared away from that portion of our trench, and the gun with its first two or three rounds breached our own parapet, and then dealt successfully with its target.

Example. Preparatory arrangements.

The actual position was finally selected six days before the attack. It was not exposed to any hostile observing stations, or to flanking rifle or machine gun fire. Accurate measurements of the trench were taken, and a facsimile trench was dug at the battery wagon line.

In conjunction with an engineer officer, the form of emplacement was decided upon. The chief point consisted in the provision of a wooden box, with a sloping hinged front, which was to be built into the parapet. (See diagram.) The facsimile emplacement was prepared accordingly, the gun placed in it, and gun drill assiduously practised (including live shell practice) by the detachment, which was composed of volunteers. Gun and sights were carefully tested, and all ammunition to be used was tested for gauge in the bore to guard against jams.

As a canal had to be crossed to reach the position a pontoon raft was prepared to carry the gun, and a thorough reconnaissance of the whole route was made. A small stream which intervened was bridged, and ramps were cut on both banks of the canal.

When the gun position had been fixed definitely, a back angle was taken to an aiming point so that the gun could be laid before the box was opened.

Occupation of the position.

Two nights before the day of attack the gun was driven down to the canal bank, being halted whenever flares were fired. It was then manhandled and rafted across the canal, and carefully concealed on the further bank, with its ammunition placed in a dug-out. Infantry assisted in this.

Concurrently, the digging of the emplacement was commenced under R.E. supervision. Wheel tracks, a foot deep, were cut for the last 30 yards of the approach to the position to give better cover. Dug-outs were prepared and strengthened for the detachment and ammunition. The epaulment was completed during the following day.

The second and final stage was carried out on the night immediately preceding the attack.

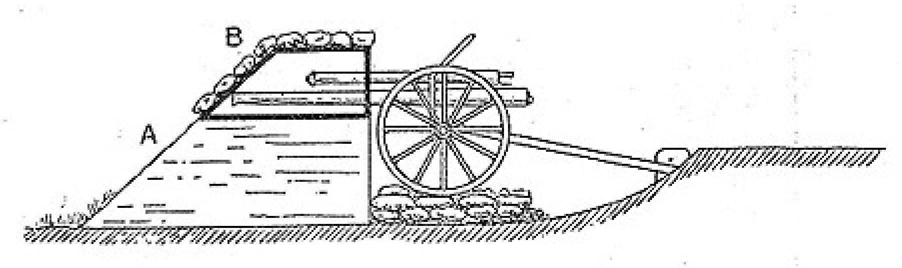
Firstly, the wooden box was inserted into the parapet. To effect this the parapet had to be pulled down on a front of about 5 ft., and to cover this gap a canvas screen was erected in front. When placed in position the box was covered with sandbags and earth, and the parapet re-built round it.

The gun and ammunition were then brought up and placed in position. Three communication trenches had to be crossed, and planks were laid for this purpose. They were not filled in so that their use by infantry might not be obstructed. In bringing up the gun a canvas canopy was carried over it, and the detachment was trained to fall flat whenever a flare went up, dropping the canopy over the carriage to hide it.

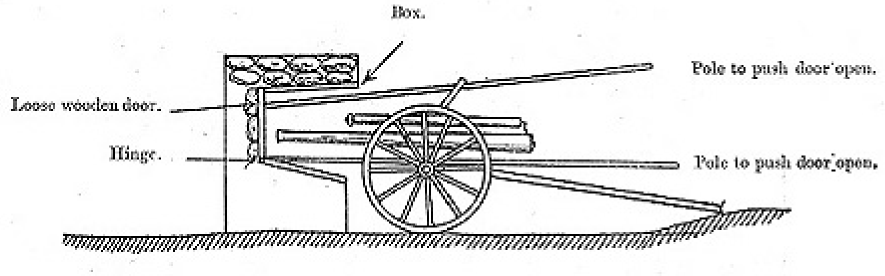
Action.

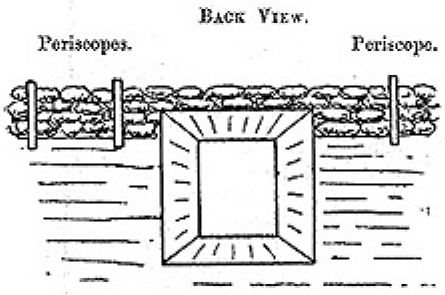
The artillery fire attack opened at 5 a.m. Covered by a salvo from a trench mortar battery in action close by, the gun opened fire and fired its 100 rounds in 9 minutes. The range was 70 yards and the objective was to destroy a T-head and the knife-rest wire by it. The T-head appeared to be demolished with the 50th round, after which the fire was directed against the knife-rests of wire. The latter were extensively piled up, being taken in enfilade.

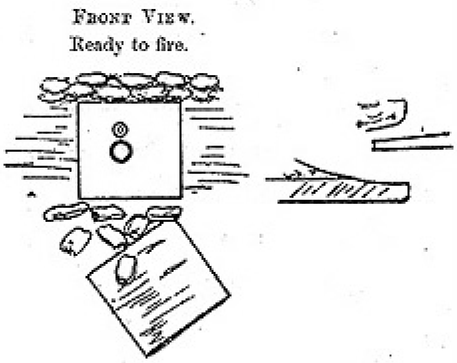
No casualties occurred during the firing, and, as soon as it was over, the detachment was withdrawn to cover in its dug-out. The gun was withdrawn on the night following the day of attack in a similar way and without loss.



The thick lines indicate the wooden box in section as placed in the parapet. At A were the hinges round which the front of the box, AB, swung when pushed front rear; the remainder of the box did not move.






FRONT VIEW.
Ready to fire.

Appendix C. PARTICULARS OF PRINCIPAL BOMBARDMENTS

Place	Date	Nation	Bombardment Duration	Bombardment Character
Neuve Chapelle	March, 1915	British	40 minutes	Intense
Festubert	9th May, 1915	British	1 hour	Intense
Festubert	16th May, 1915	British	2 days	Intermittent. No intense bombardment.
Hooge	June, 1915	British	6 days Continuous.	Intense immediately preceding assault.
Loos	September, 1915	British	4 days	Steady bombardment. No intense
Bellewarde	"	British	6 days	Intermittent
Champagne	"	French	3 days	Steady bombardment. Not intense till moment of assault.
Vimy Ridge	"	French	5 days	Steady bombardment. Intense at moment of assault.
Frise	January, 1916	German	8 hours	Continuous.
Vimy Ridge	"	German	4 hours	Very intense.
Verdun	February, 1916	German	1 day	Very intense.
The Bluff	"	British	4 days	Surprise attack in early morning: artillery opened fire 3 minutes after assault

Appendix D. EXAMPLE OF A TIME TABLE.

LINE TO BE BROKEN THROUGH. Q 2 TO V 6—

0.10.

Guns	From	To	Objective	Remarks
1 gun — 9.2-inch howitzer	0.0	0.10	Fme. Cour d'Avoue Q 9— Q 10.	
35th heavy battery (one section).	0.0	0.10	Road from house 200 yards south-west of la Quinque Rue to Fme. de Bois, taking houses en route P 14, P 15, P 13, P 16.	
35th heavy battery (one section).	0.0	0.10	From house 80 yards south-west of P 10 to Fme. Cour d'Avoue Fme. de Toulotte.	
11 — 18-pr. batteries 3 — 13-pr. batteries	0.0	0.10	Wire cutting.	
1—15-pr. battery	0.0	0.10	Enfilading wire entanglements	
2 — 15 pr. batteries	0.0	0.10	Enfilading wire entanglements and trenches in S 21 a Q 2 to R 7.	

0.10 — 0.40

Guns	From	To	Objective	Remarks
1 gun — 9.2—inch howitzer	0.10	0.40	Fme. Cour d'Avoue and P 13	Up till 0.45
1 gun — 9.2 inch howitzer	0.20	0.40	Fme. du Bois R 8	
35th heavy battery (one section).	0.10	0.40	Road from house 200 yards southwest of la Quinque Rue to Fme. du Bois, taking house en route P 14, P 15, P 13, P 16	
35th heavy battery (one	0.10	0.40	From house 80 yards southwest of P 10 to Fme. Cour d'Avoue Fme. de	

section)			Toulotte
11— 18—pdr. batteries 3— 13—pdr. batteries	0.10	0.40	Wire cutting
Ditto	0.35	0.40	Bombardment of trenches with alternate H.E. and shrapnel
1— 15—pr. Battery	0.10	0.40	Enfilading wire entanglements and trenches in S 21 a Q 2 to P 10
2 — 15 pr. batteries	0.10	0.40	Enfilading wire entanglements and trenches in S 21 a Q 2 to R 7.
4— 6—inch howitzer batteries 4— 5—inch howitzer batteries 1— 4.5—inch howitzer battery 1— 4.5—inch howitzer battery	0.30	0.40	Bombardment of trenches from Q 5 to V 6, which includes right flanks. (From Divisional Artillery)

At 0.40 Infantry assault and push on to the line Fme. Cour d'Avoue—Fme. du Bois. It is assumed that the Infantry make good the line P 8, P 10, Q 12 and the road thence to le Tourelle at 1.15.

0.40 — 1.15

Guns	From	To	Objective	Remarks
1 gun — 9.2—inch howitzer	0.40	1.15	Toulotte and post 200 yards south.	
1 gun — 9.2 inch howitzer	0.45	1.15	Orchard M 9.	
35th heavy battery (one section).	0.40	1.0	Barrage from house 200 yards S.W. of la Quinque Rue to Q 17.	
	1.0	1.15	Fine, de Toulotte.	
35th heavy battery (one	0.40	1.0	Barrage Rue de Marais from Mil to M 19 and M. 20.	

section).			
11— 18—pdr. batteries 3— 13—pdr. batteries	0.40	0.50	Fme. Cour d'Avoue Q 9— Q 10.
	0.50	1.5	Moulin d'Eau P 15, P 12, P 13, P 14.
1 — 6—inch howitzer battery	0.40	0.50	Fme. du Bois E 8 and communication trench.
	0.50	1.15	Fme. de Toulotte.
1 — 6—inch howitzer battery	0.40	"	Trenches on right flank from Q 3 to P 4 and M 9, N 12, N 13, N 14.
1 — 6—inch howitzer battery	0.40	0.50	Between Fme. Cour d'Avoue and Fme. du Boi.
	0.50	1.15	From P 18 to N 16 house and trenches.
1 — 5—inch howitzer brigade	0.40	"	Trenches on right flank from Q 3 to P 4.
1 — 5—inch howitzer brigade	0.40	1.00	Trench R 8, R 9, R 11, R 12 and road from Q 14 to R 13.
1 — 4.5 inch battery	0.40	1.00	Communication trenches to Fme. du Bois, communication trenches to Fme. d'Avoue.
2 — 18—pr. brigades	0.40	1.15	La Quinque Rue — le Tourelle road.
1 — 18—pr. brigade	0.40	1.10	Watch loft flank and barrage.
1 — 18—pr. brigade	0.40	1.10	Watch right flank and barrage.
3 — 13—pr. batteries	0.40	1.00	Barrage la Quinque Rue and Rue d'Ouvert if required.
	1.00	1.15	Mobile reserve in the hands of G.O.C. 1st Division.
1 — 15—pr. brigade	0.40	1.15	Right flank.

Further advance after 1.15, i.e., the occupation of the line la Quinque Rue—le Tourelle.

Guns	From	To	Objective	Remarks
2 guns—9.2—inch	1.15	1.45	Points M 19, M 20, M 23, M 25, M 27, M 28 and Lorgies.	

howitzers				
35th heavy battery (one section).	1.15	1.45	Lorgies, point 35 Rue du Marais, M 20, M 19.	
1 — 6—inch howitzer battery	1.15	1.35	Rue du Marais M 9, M 10, M 11, M 12, M 13, M 14, M 15, M 16.	
1 — 6—inch howitzer battery	1.15	1.35	N 17 to M 20— M 17 to M 25— M 27, 28.	
1 — 6—inch howitzer battery	1.15	1.45	Lorgies points P 32, P 31 and P 28	
1 — 6—inch howitzer battery	1.15	1.45	Houses and trenches from P 18 to Puits— N 16. Trench N 26 to P 24. Points N 23 and N 21. Points N 29, N 30, between Rue du Marais and Lorgies.	Eventually Beau
2 — 5—inch howitzer batteries	1.15	1.30	Trenches at N 6, N 9, N 10, N 11. Points M 9 and M 10.	
1 — l/3rd 4.5—inch batteries	1.15		Under Infantry Brigadiers.	
2 — 18—pr. brigades (25th and 39th).	1.15		Under Infantry Brigadiers.	
1— 18—pr. brigade (26th)	1.15		Lorgies, — Pte. Cauchiette and watch left flank.	
1 — 15—pr. brigade	1.15		Barrage from point N 11 south to L 12.	Deliberate unless rapid firing required.
1 — 4.5—inch howitzer battery	1.15		Junction of roads near P 14	2nd Divl. Artillery.
1 — 18—pr. brigade	1.15	1.35	Barrage right flank if required	2nd Divl. Artillery

12: SS109, Training of Divisions for Offensive Action, May 1916

Source: IWM SS/CDS Pamphlet collection

Not To Be Taken Into Front Line Trenches

1. The time available for divisions when out of the line to train as divisions is short. It is necessary that the utmost use should be made of it, and that the object of the training should be clearly understood by all concerned.

   Success depends on preparations for all the phases of an attack, viz.:

   a. The organization of our trenches for the assembly of the attacking force;
   b. The artillery bombardment;
   c. The crossing of the area between our front trenches and the enemy's;
   d. The capture of the enemy's defensive systems and artillery positions, and the consolidation against counter-attack of ground won;
   e. Exploitation of success.

   The training ground must be carefully reconnoitred, beforehand, and a detailed programme of the whole period must be prepared. If possible, every brigade should be exercised in each form of training.

2. The training of the division can be conveniently divided into two categories:
   a. Training for the attack from trenches against a hostile system of trenches and strong points, including the consolidation and occupation of the system won;
   b. Training for exploiting a success when the hostile systems of defence have been broken through.
3. A complete system of hostile trenches and at least the first line of a second system together with the defended localities between these two systems, should be marked out on the hostile ground to full scale from trench maps and aerial photographs, to represent as far as possible an actual system of trenches and strong points. The assault over the area so marked out should be practised several times by the division as a whole; the division being disposed in depth on a narrow front with two brigades, and also with one brigade in the front line.

   A suitable assaulting front for a brigade against a strong objective may be taken at from 400 to 600 yards. The average front for a division forming part of a larger force in an attack, however, must be governed by the nature of the country to be traversed, the difficulty of the task allotted, the intervals to be allowed between formations, the number of important objectives to be assaulted, and the number of brigades to be employed in the front line. It may be taken at from 1,000 to 1,800 yards, or an average of about 1,500 for several divisions in a decisive attack.

4. The attack must aim at continuity and must be driven home without intermission, so that the attack gradually works forward till the endurance of the enemy is broken down.

Every attacking unit must be given a limited and clearly defined objective, which it is to capture and consolidate at all costs; the assaulting columns must go right through above ground to this objective in successive waves or lines, each line adding fresh impetus to the preceding line when this is checked, and carrying the whole forward to the objective. The cleaning up and consolidation of positions passed over by the assaulting columns in their advance, the formation of protective flanks, and the preparation of strong supporting points in the captured area will be carried out by other troops of the attacking force, following the assaulting columns and specially told off for the purpose. Local reserves must be held to reinforce those parts of the line which are checked, to fill gaps opening in the front and to relieve troops which are exhausted and whose endurance has gone.

From the moment when the first line of assaulting troops leaves our front trenches, a continuous forward flow must be maintained from the rear throughout the division. Up to our own front line this flow may be either above or below ground, according to topographical conditions, the nature of the enemy's fire, and the number of communication trenches available, but once the assaulting troops have left our trenches and are pushing on to their objective, their movement will be carried out above ground.

The movement of the Divisional Reserve may be controlled when required by ordering beforehand that its forward flow is to be checked on reaching some definite line (such as our original first line of trenches), in which it will await orders.

5. When a particular line or succession of lines have reached an objective assigned to them, for the consolidation of which preparations have already been made, it will usually be inadvisable to order these troops to push on to a further objective. It follows, therefore, that, to secure continuity in operations on a large scale, it may be necessary to arrange for fresh troops to pass through others.

Occasions may also occur in which there is, beyond the first objective, a second objective, e.g. another system of hostile trenches or centre of resistance, which the Commander of the formation intends to attack, conditionally on the first attack succeeding, with a fresh body of troops, but as part of the same operation.

Divisions must, therefore, be practised in the passing of a fresh body of attacking troops through the troops which have carried out the first assault and have reached their objective. The second assault will be carried out on the same principles, the assaulting columns going straight through to the objective in successive lines.

The passing of one body of troops through another during an attack is, however, an extremely difficult operation, and should only be attempted when there is a reasonable opportunity of seizing and holding the second objective by immediate attack, as for instance when the first attacking force has succeeded in gaining the whole objective it was ordered to consolidate, the artillery preparation on the second objective has been adequate and effective, and the force detailed to attack it is well in hand.

The conditions of every attack vary, however, and a special solution must be found for each individual problem. It depends on whether the furthest objective that has been allotted to a division can be reached in one continuous advance, or whether it is necessary to capture and consolidate some intermediate objective before the final one can be assaulted.

6. With regard to the above, it is impossible to lay down any definite rules as to the strength of assaulting columns, the number of lines of which they consist, or the distance apart of these lines.

The depth of the assaulting column depends on the distance of the objective, and on the opposition that has to be overcome in reaching it. Its strength must be calculated so as to give sufficient driving power to enable the column to reach its objective and to provide sufficient remaining energy to enable the objective to be held when gained. The distance apart of the lines will usually be regulated by the rate at which the successive lines can be formed up and moved forward over the parapet. The men in each line should be extended at two or three paces interval. In this connection it is worthy of consideration that in many instances two lines have generally failed but sometimes succeeded, three lines have generally succeeded but sometimes failed, and four or more lines have usually succeeded.

7. In these exercises the attack or part of it should frequently fail to reach its objective, and the commanders of the units thus checked be confronted on the spot with a new situation and practised in making rapid decisions based on the original plan.

Every brigade in turn should be called upon to move from reserve to the capture of an objective, in front of which the assaulting troops have been held up, or against which an attack has failed. The orders for this operation and a description of the artillery support that will be available will be given to Commanders on the spot.

8. Any division may be in reserve to one or more assaulting divisions. Such a task requires as careful previous preparation and study as does the task of the divisions actually detailed for the assault.

The staffs and regimental officers of the division in reserve on any portion of the assaulting front must make themselves familiar by personal reconnaissance with the trench systems over which they may have to operate and with every detail of the ground. They must be provided with the same maps as those used by the assaulting division. The Staffs and higher Commanders of the division in reserve must study the plans and preparations of the assaulting divisions as closely as if they were their own. In this way only will they be able when the time comes to take up the attack without hesitation, and with a clear understanding of the task before them.

From the moment the operation begins, the closest liaison must be established, in accordance with arrangements made beforehand; and responsible Staff Officers from the Reserve Division should be attached to the Headquarters of the Divisions in front so as to follow every development of the action. As soon as it is known where the reserve division is to be put in, the proper place for the Commander of the Reserve Division and his Staff is at the Battle Headquarters of the Divisional Commander, who is controlling the operations in that particular portion of the battlefield.

9. Special exercises should be held during the period of training by Divisional and Brigade Commanders with all their staffs and subordinate commanders:

   a. To consider in detail the preliminary arrangements for an attack on a large scale; and
   b. To consider the action to be taken by subordinate commanders when local unexpected situations arise, such as occur when a portion of a line is held up, impassible obstacles are encountered, or it becomes necessary to deliver or repel a local counter-attack.

With regard to (a), attention is directed to the memorandum on the preliminary arrangements in case of a large attack, issued with O.B./1207, dated the 2nd of February, 1916. The artillery programme and co-operation should be worked out in all exercises and explained to all concerned.

With regard to (b), it must be remembered that officers and troops generally do not now possess that military knowledge arising from a long and high state of training which enables them to act promptly on sound lines in unexpected situations. They have become accustomed to deliberate action based on precise and detailed orders.

Officers and men in action will usually do what they have been practised to do or have been told to do in certain situations, and it is therefore all the more necessary to ensure that a clear understanding should exist among all ranks as to what action is to be taken in the different situations that may arise in battle. In this connection every endeavour should be made to inculcate mutual confidence and the spirit of combination directly towards the achievement of the task set. During an advance under fire men must possess the habit of looking spontaneously to their leaders for direction; more often than not leaders have to look for and find their men. Even this in itself is not sufficient. Situations will constantly arise when there is no officer or non-commissioned officer present with groups of men, and the men must realise that, in such a case, one man must assume leadership on the spot and the remainder act under his control.

All must be prepared for heavy casualties, and must realize that the magnitude of the interests at stake necessitate the greatest self-sacrifice from one and all.

10. Brigade Headquarters, as well as Battalion Headquarters, must be

practised in moving forward during the progress of an attack, and it is essential that communication from front to rear must not be lost. It is, therefore, necessary that the route to be followed by Headquarters should be well defined and known, so that runners both from front and rear will know the route to follow in order to pick up the Headquarters should it be moving. In the case of Brigade and Battalion Headquarters it will usually be inadvisable to state a place to which the Headquarters will move, as that place may be inaccessible or untenable.

A thorough system of good communication throughout the division is of the first importance, and every kind of alternative form of communication from front to rear, including parties of men, under specially selected officers, detailed as runners, must be continually practised throughout every exercise both day and night. All ranks must be warned of the vital importance of forwarding accurate and speedy information. This portion of the training will receive the special attention of the higher Commanders.

11. With regard to the latter part of paragraph 2 (a), attention is directed to the memorandum on the consolidation of trenches and localities after assault and capture (O.B. 1629, dated 4-5-16) already issued.

12. With regard to the second category of training (paragraph 2 (b)), the general principles laid down in our training manuals hold good, and special attention is directed to Chapters V, VI, VII, and IX, Field Service Regulations, Part I. Special exercises should be carried out by divisions to practise the continuation of the advance after a hostile system of defences have been broken through.

Such an advance will probably take the form of a series of attacks on tactical points which are still held by the enemy by portions of the force, whilst other portions continue a vigorous advance (105.5).

Special attention should be given during some of these exercises to the methods of establishing a defensive flank to the division as it advances, and in all exercises the general principles of securing the ground gained must be carried out (see paragraph 11 above).

13. In all exercises the following points require special study on the part of Brigade and Battalion Commanders:

    a. The employment of Brigade Machine Gun Companies and Lewis guns, to ensure that full advantage is taken of this great increase in fire power. In particular, opportunities should be looked for to practice pushing forward Lewis guns to precede the attacking infantry or to reinforce an advance which is held up.

       Attention is directed to "Notes on the Use of Lewis Guns in an Advance," dated the 18th March, 1916, and "Notes on the Tactical Employment of Machine Guns and Lewis Guns" (S.S. 106).

    b. The use of bombers (see S.S.398 "Training and Equipment of Bombers").

c. The use of Trench Mortars.

d. The arrangements for getting all the above forward as rapidly as possible and keeping them supplied in action.

14. The service of supply, also, both as regards ammunition, food and water, should be carried out thoroughly in every detail, at least one exercise of this nature being carried out after dark.

15. The following points have proved the chief stumbling blocks to a complete success in past attacks, and every effort must therefore be made to overcome them:

a. Failures in mutual support. Every endeavour must be made to maintain lateral communication; when a gap occurs in the line, whether caused by the failure of some portion of the force to reach its objective or otherwise, the troops on either side of the gap, who have reached their objective, must at once close the gap by extending inwards, or by pushing into the gap their nearest available reserves, and in this way both re-establish lateral communication and isolate any hostile detachment which is holding out. The value of machine guns to fill a gap of this kind should be borne in mind.

b. Failures in passing on information as to the situation. The vital importance of information and the responsibility of everyone in assisting to obtain and forward it must be impressed on all ranks.

c. Failure to re-organize and to consolidate the ground won in time to resist a counter-attack. Every effort must be made to retain control and cohesion, and every suitable opportunity of reforming must be taken. Consolidation, on the principles laid down in the memorandum referred to in paragraph 11, must be carried out with all speed and determination.

d. Unnecessary crowding of the assaulting columns, with the consequent increase in casualties and congestion. It must be borne in mind that beyond a certain point the addition of more men merely results in hampering an attack.

e. Premature using up of reserves. Every commander must make arrangements to retain control of his reserves till they are required for some definite purpose, and must not allow them to drift into the fight piecemeal and with no clear guidance as to their objective.

16. The strictest attention must continue to be paid to the cultivation of the power of command in young officers, also to discipline, dress, saluting, cleanliness and care of billets, and the importance of strict obedience to instructions as regards arrangements of supply, preservation of iron rations, water, etc., must be impressed on all ranks.

Self-denial in the matter of water in particular must be practised; men must accustom themselves to not drinking out of their water-bottles without orders, and control over the men in this respect will be exercised by officers during operations.

Too great stress cannot be laid on developing good moral, a soldierly spirit, and a determination in all ranks to achieve success at all costs.

17. Troops once launched to the attack must push on at all costs till the final objective is reached.

It must be impressed on all ranks that "decisive success in battle can be gained only by a vigorous offensive" (F.S.R. 99.1), and in no operation of war is rapidity and determination more important than in exploiting a success after breaking through a hostile system of defences.

To ensure success it is impossible to exaggerate the vital importance of thorough training of all ranks, so that all may feel convinced that "when we fight we win."

L.E. Kiggell, Lieut.-General, C.G.S.
G.H.Q., 8th May, 1916

13: Notes on Artillery, June 1916 (Compiled by the General Staff.)

Source: WO33/756

These Notes have been compiled from suggestions made by artillery and infantry Officers at the courses held at Aire. They are intended primarily for the use of Battery and Battalion Commanders belonging to new Divisions, who have not had previous experience of the present class of warfare.

(A.)—CO-OPERATION OF INFANTRY AND ARTILLERY IN TRENCH WARFARE.

1. *Arrangements for Defence.*—A certain force of artillery is detailed for the support of each infantry brigade holding a portion of the line. Batteries are then allotted to each Sector. Arrangements are made to cover the front with rifle and machine-gun fire, and the places are selected where artillery fire is required. A code letter and number is given to each place on which guns are layed, and a sketch showing the code should be kept by the Company Commander in the trenches, by the Battalion Commander, at the O.P., and at the battery. A direct line is laid from company headquarters to the battery, tapped in at the O.P. and battalion headquarters, and the Company Commander provides the instrument and personnel at his end of the line. When fire is required at night on any particular point, it is sufficient to telephone down the code letter and number, and the gun concerned opens fire at once. Long discussions on the telephone as to the exact location of the target are thus avoided, and any correction can be made after the first round. If fire is required on any other place, it should be described with reference to one of the selected points. These points are usually referred to as the "night lines" of the battery.

   When infantry reliefs take place, Battalion and Company Commanders should see a round or two fired the day before they come in, so that they may know where they can expect help.

2. *A Hostile Attack.*—Special arrangements must be made to meet a hostile attack by night, in a fog, or under cover of smoke and gas. Time is the essence of the problem, and it is more important to start guns firing at once than to wait for discussion on the telephone as to the exact position where the enemy has been first seen. Every gun should be normally layed on its "night line" when not otherwise engaged, and on receipt of a pre-arranged signal will open fire at once on this line, "sweeping" a certain amount where necessary. The Officer at the battery then endeavours to ascertain the situation, but if the wires have been cut, he must use his own discretion as to continuing fire.

   An alarm signal is necessary, and the occasions on which it should be used must be clearly understood. Every precaution should be taken to prevent it spreading needlessly to neighbouring units.

   It is advisable to test the alarm signal occasionally, but this must be done with caution. The Brigade or Division Commander, in consultation with the C.R.A., should alone be empowered to apply a test.

The telephone communications between the artillery and infantry should be tested frequently by day and night.

The infantry must clearly understand that, on receiving the alarm signal, the guns open fire on their pre-arranged "night lines," and that this signal is therefore only to be used while our infantry are in their present positions. If our infantry have captured a hostile trench and require artillery support at short notice, some other form of code should be used, as the use of the ordinary alarm signal in this case would lead to fire being directed on our own troops. V.V.V. followed by the name of the regiment requiring assistance is suggested as a suitable code when fire is required in front of a captured trench.

3. *Aggressive Action.*—In order to reap full benefit from aggressive artillery action, it is essential that, as on all other occasions, the infantry and artillery should co-operate closely in the work of destruction. We must use every means to entice the enemy from his dug-outs, and then catch him with 18-pr. shrapnel, machine-guns and rifle fire. Various methods are :
    i.
        a. To damage the enemy's front parapet with H.E. from howitzers and field guns, and cut his wire with 18-pr. shrapnel. He will then have to come out from behind cover to execute repairs, of which advantage should be taken by both artillery and infantry.
        b. Enfilade fire on communication trenches, especially at their junction with the main trench, and on front trenches at intervals both by day and night. Two or three rounds at a time, or a couple of battery salvoes, might easily do considerable damage, and are less likely to give away a battery at night. After the first few rounds the enemy will probably take cover, and further shooting is waste of ammunition. A single gun placed well forward to enfilade the enemy's front line trenches has been found very effective, and the flash can be entirely screened, except from the place at which it is shooting.
        c. Occasional rounds or salvoes of shrapnel as above, fired on cross roads, billets, or known headquarters especially at night on reliefs, ration parties, working parties, &c.
        d. Destruction of hostile observing stations, strong points, &c., with H.E.

    ii. The enemy probably stands to arms as we do, at dusk and dawn. It is suggested that on given evenings and mornings, our infantry should be warned and all the field guns covering a brigade front should fire a couple of rounds of shrapnel per gun, at a pre-arranged signal, on the enemy's front trenches. After the first two salvoes he will probably take cover.
    iii. Anything unusual which will make him look to see what is happening and have the effect of making him man his parapets, e.g., burning fires all along the British line at a given hour, red fuzees used in the same way, cheering

or a groan along the line, cardboard figures all along the parapet, loud ringing bells, rapid bursts of infantry fire. In every case the artillery must be warned and two or three rounds of shrapnel per gun fired on a given signal. This will probably kill more Germans, and is a more effective means of "retaliation" than prolonged bursts of fire which are expensive in ammunition.

When the enemy's infantry are in their trenches, firing at one of our own aeroplanes, a suitable opportunity for artillery to open fire on their front or support trenches will probably present itself.

Shrapnel could also be usefully employed at a house burning in the enemy's lines, at points from which Very lights are usually fired, or at places where heavy rifle fire is heard.

When a portion of the enemy's line is being bombarded he often withdraws the garrison to either flank. A rapid switch might often inflict casualties. Trench mortars should fire in co-operation with artillery when possible.

4. *Information.*—The artillery require all the assistance they can get as to the location of targets and the effect of their fire. Every endeavour should be made by the infantry to assist, and artillery observing stations should be connected to the front trenches and to divisional and artillery observation posts, for this purpose.

Young infantry Officers should be instructed in artillery methods of describing position of targets, and it is a great advantage to both branches of the service, if every infantry Officer in turn spends a few hours in the artillery observing station overlooking his part of the line. It helps him to know the country from an artillery point of view, knowledge which would be especially useful when the time came for an attack. In describing targets, reference should always be made to points in the enemy's line not to portions of our own line, and consequently all prominent objects in the enemy's line should be given the same name by both artillery and infantry.

A series of photographs are being taken from all artillery O.Ps. They will enable infantry and artillery Officers to study the ground together, and will be invaluable to battalions and batteries coming into the line of relief. Combined with a large issue of air-photographs, they will enable all officers to get a good idea of the ground over which they may have to advance.

5. Position of Battery Commanders and Observing Officers.—An Officer from each of these batteries must be at his O.P. while there is daylight, and an Officer or N.C.O. must always be on the look-out. During the present trench warfare a subaltern should normally perform this duty, and the battery commander reserve himself for special shoots; he should usually be employed in training his officers to direct and observe fire, and in keeping in touch with Battalion and Company Commanders. The personal element is of great importance in the co-operation of artillery and infantry.

By night an Officer of the battery must be in close touch with the battalion he is supporting. It depends upon circumstances whether he should be at his O.P. or at battalion headquarters, but in any case he must be in communication with the latter. See also B, para. 3.

(B.)—CO-OPERATION BETWEEN ARTILLERY AND INFANTRY IN THE ATTACK.

6. *Plans for Attack.*—Should be made in consultation with the artillery, as the actual point selected for attack must depend largely on where artillery support can be most effective. It is especially necessary to consider where wire can be cut and where it is impossible on account of the configuration of the ground.
7. *Artillery Preparation.*—A series of bombardments and lifts over a wide front and lasting several days is a useful method of concealing the front selected for assault. The preliminary bombardment, which is to prepare the way for an attack, should vary in duration and intensity, so as to give the enemy no indication as to the actual moment of assault. A prolonged intensive bombardment with a sudden "lift" is a sure sign to the enemy that an assault is about to take place, especially if accompanied by heavy rifle fire from the flanks of the attacking troops. During the bombardment the infantry should creep as near to their objective as possible, and the assault should be delivered without any sort of "flourish of trumpets."

   Trench mortars should take their part in the preliminary bombardment, and in helping to cut wire in certain places. Definite tasks should be allotted to them when the plans are being made.

8. *Position of Brigade and Battery Commanders.*—The Commander of the artillery Brigade or "Group" supporting an infantry brigade should be in close touch with the infantry brigadier, and if possible actually with him. Battery Commanders must be where they can best see the general situation (usually their O.Ps.). Once the attack has been launched the situation changes so rapidly that there is often no time to receive orders from the rear, and battery commanders must be prepared to act instantaneously on their own initiative. It is not fair to shift the responsibility for the conduct of fire on to the shoulders of a junior Officer, and this applies to all batteries whether Field, Heavy or Siege.
9. *The Assault.*—Artillery fire must "lift" from the actual places to be assaulted, but H.E. from howitzers and field guns must be kept up on the immediate flanks of the attack. Field guns dug in near our front parapets are especially useful for this purpose and can also be used to make breeches in the hostile parapet just before the assault, and to knock out machine-gun emplacements both before and during the assault. These guns might subsequently be usefully employed for the close support of a battalion in its advance.

   It is now the business of the artillery—

   a. To keep down the fire of the hostile artillery. This is done by the counter-batteries.
   b. To prevent the enemy bringing up supports and reserves. For this purpose a steady fire must be kept up on his communication trenches, ditches, and other possible lines of approach, cross-roads in rear, and places where the enemy might mass for a

counter-attack. The "box-barrage" is usually a waste of ammunition, but arrangements must be made to make a barrage at short notice in case the enemy decides to bring his troops up across the open.

The "lifts" want careful timing, and should be very gradual, of the nature of a creep, arranged to suit the pace at which the infantry are likely to make progress: it is often impossible, owing to dust, smoke, &c, to see exactly where the infantry have got to.

When smoke and gas are employed, the fire of the heavy artillery must be well lifted to avoid dispersing the gas.

10. *The Advance to the First Objective.*—To enable the infantry to make steady progress the continued support of artillery is required. A lull in the artillery fire usually occurs shortly after the assault has been delivered, owing to the difficulty of ascertaining how far our infantry have advanced, and what is stopping their further progress. Brigade and Division Headquarters have usually great difficulty in obtaining this information and in any case it generally reaches the battery commander too late to be of use. It therefore devolves on the latter to act on his own initiative, and he must place himself where he is best able to do this. He must keep touch with his battery and with the general situation, and for this reason it is seldom advisable for him to press on too far.

The battery commander must have another Officer known as the F.O.O.:

. To keep touch with the infantry commander whom he is supporting;
a. To keep him informed as to the exact position of our infantry;
b. To assist him in ranging on to anything that is checking the advance of our infantry.

This F.O.O. must be provided with telephone equipment and also with signalling screens, as the telephone wires will almost certainly be cut. In selecting his position he must remember:

c. That his business is to assist his battery commander—not to join in the infantry fight.
d. That his information is of no use unless he can get it back to his battery commander.

It will, therefore, seldom be advisable that he should be actually with a company or even a battalion commander in the front line, but he must keep the latter informed of his whereabouts, and be ready to visit him if required. The best position will usually be the farthest point forward to which good communication has been opened up, normally battalion headquarters. It will then devolve upon the infantry to let him know of their requirements, and here again it is most necessary that reports shall be intelligible to the artillery. Much of his information must be obtained from wounded officers or N.C.Os., and he must depend on his ears as much as his eyes.

Some form of light signal, which shall be visible to aircraft and the artillery through smoke and mist, is required to let everyone know when the infantry have gained a certain objective. It must be something that can be carried by every man, and small magnesium lights are suggested. They could be thrown back behind the objective, so as not to attract the attention of the enemy. Flags have been used but they generally get left behind, and are then very misleading.

Definite zones of action must be allotted to brigades and batteries. They must keep to their own zones and not be enticed by a tempting target to shoot on any other except under very exceptional circumstances. Otherwise several batteries may be ranging on to one target at the same time, and the difficulty of distinguishing their own rounds may lead to a total loss of effect.

11. *Advance of Artillery.—*

. When Artillery can advance in daylight. — Guns must be pushed forward in support of the infantry, the advance being supported by fire from other field batteries and by the heavy artillery. In many places emplacements can be prepared beforehand near our original front line, but they must be carefully made and concealed. In any case a careful reconnaissance must be made beforehand and positions and observation stations allotted to batteries as far as this can be done. It may sometimes be possible to push up sections or single guns in support of the infantry when it would be impossible to send forward a complete battery, the section commander being placed under the orders of the commander of the battalion he is supporting.

The 4.5-inch howitzer is especially useful for the close support of the infantry, as it can be placed under cover in positions where the 18-pr. could not clear the crest. Armoured cars might also be usefully employed, for this purpose.

Excellent results can be obtained by combining the fire of 18-pr. and 4.5-inch howitzer batteries, the howitzers being used to bolt the enemy from cover, and the guns to shoot him when bolted.

a. When artillery cannot move until dark.—Often, however, the country will not allow of the guns being brought up until dark. It will then be necessary to dig in some guns beforehand, in or near our front line, and not allow them to be used until our infantry have reached their first objective. In the case of a Corps attacking on a narrow front with two divisions in front line and one division in reserve, it would be a suitable arrangement to use the field artillery of the reserve division for this purpose. This latter division would then have the support of its own artillery for the attack of the enemy's second line, and would have it handy in case of a further advance.

(C.)—SPECIAL TASKS OF THE ARTILLERY.

12. *Enfilade Fire.*—Great attention should be paid to this, both for attack and defence: batteries, sections, or single guns should be so placed as to get the

maximum amount of enfilade fire to bear on the enemy's trenches, and on their communications.

The great advantages of it are often not fully appreciated. The flashes of guns can be concealed from observation except in the one direction, and the enemy cannot get an intersection on the flash. When firing against deep trenches, much better effect with shrapnel can be expected, and in the case of howitzers, it is much easier to obtain direct hits on the trenches.

It is noticeable that the enemy take every opportunity of bringing enfilade fire to bear; and in all the recent fighting those guns which opened fire were so placed.

It is often undesirable to place the guns of one division in the area of another division, and then this enfilade fire should be brought to bear by the batteries of a neighbouring division. This is arranged within the Corps, or if two Corps are concerned, is done by the Army, and the guns come under the command of the division whose front they are covering at the time.

13. *Wire-cutting.*—Good platforms and secure anchoring of guns are necessary to ensure accurate shooting, and guns must be overhauled by the artificer, and carefully calibrated beforehand. If the trail-eye is raised, or the wheels are lowered until the gun recoils along the trail, "side-slip" and "jump" are practically eliminated and much more accurate shooting is obtained. This also applies to guns run up to the front parapet to shoot at point blank range; the trail should then be raised till nearly horizontal.

It is now generally agreed that 18-pr. shrapnel is the most effective projectile, burst as close to the wire and as low down as possible. Experiments with H.E., whether burst on graze or with No. 100 delay action fuze, have given practically no effect against wire, but about 10 or 15 per cent. H.E. mixed with shrapnel is sometimes useful for dispersing the posts and the wire when cut. On hard ground percussion shrapnel is very effective.

The best ranges have been found to be from 1800 yards to 2400 yards, and five or six rounds per yard are then required for an entanglement ten yards deep. Wire can be cut up to about 3200 yards with a much larger expenditure of ammunition, but at longer ranges the 18-pr. gives little, if any, effect. In all cases close observation is essential, and it may sometimes be necessary to make special arrangements for this, e.g., by sapping forward and establishing O.Ps.

The 6-inch howitzer has been effectively employed against wire between 3000 and 5000 yards, and distant wire has been cut by 60-prs. firing H.E. with aerial observation.

Trench mortars should also take part in wire-cutting; the 2-inch is particularly useful.

Before artillery attempt to cut wire, infantry patrols should be sent out to report on the nature and extent of the wire, looking especially for low trip wires where the grass is long. They should also report on the progress of destruction. For distant wire this information can only be obtained from air photographs.

The following notes on German wire entanglements may be of use to our own infantry and R.E. :

. Iron posts are more difficult to destroy than wooden posts.
a. Heavy coils of loose wire on iron posts or on broken ground are particularly difficult to destroy.
b. The effect on trestle wire is easier to observe than on staked wire.
c. Broken ground or a small bank in front of the wire greatly adds to the difficulty of cutting. Wire placed in a depression is similarly protected.
d. A soft bank of earth behind the wire prevents it being swept away.
e. Wire among bushes is hard to see, and it is difficult to tell if it is cut or not.
f. Wire entirely hidden from view will seldom be cut.
g. An irregular line with small salients is harder to range on than a straight line of wire.

14. *Bombardment of Trenches.*— Unobserved fire is useless and leads to waste of ammunition. Every round should be observed, either from an O.P. or by aeroplane. An exception must be made to this in the case of night firing to prevent the repair of wire and to prevent movements along the trenches and roads which have been carefully registered beforehand. It should be explained to the men in the trenches that shrapnel to be effective must burst short of its target. When our front trenches are very close to those of the enemy they must expect the shrapnel to burst a very short distance in front of them. Similarly in a bombardment of the front trenches by howitzers, they should understand that the pattern made by a number of perfectly laid rounds is an elongated one, and that very little damage is being done to the enemy unless about 20 per cent, fall on our side of his parapet. When only a short distance separates the trenches the infantry must be cleared from our own front line if possible, as there is always the risk of an abnormally short round.

15. *Counter-battery work.*—To neutralise a hostile battery, a few rounds at a time, repeated at intervals, are more likely to stop it firing than a large number at one time. To destroy a battery that has been accurately located a considerable expenditure of ammunition is allowable, provided continuous observation is possible. When a battery is being dealt with, shrapnel should be distributed in rear and on the flanks of the battery in order to catch the detachments. Fire should be kept up at intervals throughout the night to catch the men and teams who will probably be attempting to shift the guns.

16. *Registration.*—A form of target register is being issued to all batteries. All ranges must be reduced to the normal of 60° P. and 30" barometer before being entered up in the register. The "error of the day" can then be obtained by firing "sighting shots" at a plainly visible target, and this correction applied to the ranges obtained from the register. This register is to be handed over on relief to the incoming battery, or to the C.R.A. of the Division if the position is not being re-occupied immediately. To obtain full value from this method of registration, all guns must be carefully calibrated. A Log Book in the form of an Address Book, showing all the information gained by a battery on its front, would be very helpful to a relieving battery.

Much ammunition is wasted by constant re-registration unless a systematic method is adopted and handed over to relieving batteries. A correction scale is being issued, and should be employed to reduce ranges obtained on any one day to the normal given above.

(D.)—CONCEALMENT.

Observation stations and batteries must be adequately protected, and every precaution taken to conceal guns, detachments, and the approaches to a battery. As far as possible all movements in or near, the battery must be stopped when a hostile aeroplane is overhead, and nothing should be left lying about which would catch the eye of an observer, such as empty tins, &c.

The following information has been given by the R.F.C. :

17. Positions are given away by—
   . Tracks leading directly to the guns and to no other place. Special precautions will have to be taken in case of snow.
   a. Guns placed in a straight line at regular intervals,
   b. The dark embrasures and entrances to dug-outs.
   c. Flashes. Gun flashes can be concealed by screens, from observation directly overhead, but not from the front unless the gun is firing in enfilade. Howitzer flashes can be concealed from the front, but not from overhead observation.
18. The positions most difficult to locate and range on are those—
   . In broken ground, especially in the vicinity of heaps of rubble or mounds.
   a. Behind houses or in woods.
   b. When the guns are dotted about an open field at wide intervals.
   c. Where there is no prominent object close by to assist ranging.
19. Hostile aeroplanes generally observe from a position over their own lines. A slight hedge about 150 yards in front of a battery has had the effect of "false cresting" the battery, as seen from an aeroplane, and resulted in the expenditure of many rounds on the hedge.
20. An experienced observer is not deceived by dummy flashes unless these are very carefully engineered. The emplacements from which they are fired must appear to be occupied, and should have tracks leading to them. If possible a gun should occasionally be run in and fired from the position. The flashes must be carefully timed to coincide with the rounds from a battery that is actually firing.
21. Unoccupied gun positions should not be left derelict. The gun emplacements should be kept intact to induce the enemy to believe that they are still occupied. They will often make good positions from which to fire flashes.

(E.)—COMMUNICATIONS.

The underlying principle of all artillery communications is that it is of vital importance to enable the G.O.C. to bring overwhelming fire to bear on a given locality at the shortest notice.

Telephonic communications require careful supervision and co-ordination to avoid waste and confusion. A suggestion has been made that special communication trenches should be constructed for telephone wires only, and this may sometimes be possible. A multi-core cable containing 10 lines has been used with advantage to replace the same number of single ones. It can be well dug in and protected. All the telephone equipment and wires of a battery should be under the charge of one man, who will be responsible for their maintenance. The signallers must not be allowed to tamper with telephone instruments.

Talking on the telephone leads to much conversation and often to inaccuracy in ranges, &c. It disturbs other people, and allows the signaller to forget buzzing, which may be the only means of communication in the noise of an action. Talking should be reserved for Officers. The signallers will then rapidly improve in buzzing, and it will eventually be nearly as quick as talking, and much more accurate.

Every endeavour must be made to supplement the telephone with visual signalling. Electric lamps are useful for this purpose, and signalling screens must also be obtained for use by F.O.Os. in case of emergency.

Every artillery officer should be a signaller, and can soon become so with half-an-hour's instruction daily.

N.B.—These notes are not official

14: Report on Visit to III Corps, c. June 1916

by Brig. Genl. R. P. Benson, Commanding Heavy Artillery, V. Corps.
Source: WO 95/757

General Arrangements for Artillery.

1. (a) There are 4 Divisions in the Corps, of which two will attack whilst two are in reserve.

   (b) The Artillery of three Divisions only will be in action, the Artillery of C Division being split up between A & B Divisions and, until the final objective is reached will be under the orders of the C.R.A.'s A & B Divisions.

   (c) One Brigade of C. Divn. Artillery is dug in in a forward position on both A & B Division fronts and, in each case one Brigade is kept mobile.

   (d) The forward Brigades will not register or open fire until the Infantry have advanced some distance. After this they will join in in the barrages of the different lifts, so that, when practising the final bombardment gaps are left in the Divisional Artillery barrage on the 4th and succeeding lifts, which are closed up by these forward Brigades on the day of Assault.

   Arrangements for advance.

2. (e) On the day of Assault (Z day) when the Infantry have advanced considerably, the Mobile Brigades start their forward move and move to a position previously selected on the map in the enemy's lines and on the outer flanks of the Divisions with their special objectives told off.

   (f) They are followed as soon as possible by the Brigades of A & B Divisional Artillery which are furthest back from the enemy lines, and if possible on Z night all the Divisional Artillery will be got forward in positions between the Mobile Brigades being careful not to select positions West of a given North & South line, as these Westward positions are reserved for the Heavy Artillery. This advance will take place under the protection of the Heavy Batteries.

   (g) On the night of Z plus 1 the 60 pr batteries and the horsed 6" batteries will be advanced and also some 9.2" platforms horse-drawn. If it is impossible to get all forward every endeavour will be made to get forward anyhow single guns.

   (h) On the night of Z plus 2 the 6" tractor drawn batteries will move followed by 9.2" drawn by horses. The 8" and other heavy howitzers will move when the roads are made good which must be done as rapidly as possible by Divisions.

Roads.

3. The lines of advance are named beforehand, and carefully marked with small yellow flags every 50 yards and the bridges are specially marked, the number of bridges required is noted and the Divisional Artillery is told for which routes they are responsible. As soon as possible lorry circuits are arranged for and all must understand that when two bridges are available, the right hand one must be used.

Bridges.

4. The bridges are of two sorts: —

(k) In two parts to take a weight of 5 tons carried on the tops of wagons, those bridges should have a ribband, on either side, 9" high, to prevent poor drivers from over-riding the edge, and so blocking the whole advance, they must be made wide enough to take a 60 pr. and they will take either 60 prs. or 6" howitzers.

(l) In one piece, to take 7 tons, mounted above a pair of G.S. Wagon wheels & drawn by two horses. To use this latter bridge when the trench is reached, the horses are unhitched and the pole taken out and the whole is run forward by hand, the wheels falling in the trench and the bridge remaining in its place. All bridges over our own trenches must be put down before Z day. There are 28 bridges of the first sort with each of A. B. & C Div. Artilleries and 20 in reserve, and 20 bridges of the second sort in reserve. When the advance commences, parties of pioneers should be ready to at once fill up what trenches they can so as to allow the Divisional bridges to be taken further forward.

Provision of cover.

5. At first after the forward move, batteries will be in the open, and the order of urgency of work in the new positions is as under: —

i. Trenches to shelter detachments.
ii. Guns dug in.
iii. Men's shelters covered where possible with captured material or material brought up from first position.

It is wise to take up some camouflage grass and where it is impossible to take forward rabbit wire; rolls of fishing nets are invaluable.

Liaison and control.

6. (m) With each Battalion Commander is a Subaltern of Divisional Artillery and with each Brigade Commander a Major or Captain.

(n) The H.A. Group Commander of the Group especially supporting each Division has battle headquarters close to the C.R.A. of the Division. He is thus able to get immediate information, after the assault has commenced. He is not under the orders of the C.R.A., but, subject to his carrying out the pre-arranged scheme he will do all that is possible in any emergency, reporting his action at once to the Heavy Artillery Commander.

(o) The G.O.C. Heavy Artillery of the Corps has under his immediate control the heavy batteries and a freak group consisting of very heavy howitzers for counter-battery work and special tasks. In order to avoid disarrangement of existing communications, maps, etc., he remains in peace headquarters.

(p) When the heavy batteries and horsed 6" howitzers advance the latter come temporarily under the heavy battery Group Commander, who keeps in touch with the Divisional C.R.A., but is independent of him.

Supply, etc.

7. (q) Corps dumps have been made well forward for supplies, forage, etc. Every battery has drawn three days rations of bully beef, etc., and in addition they have been enjoined to save all the bully that they can from their daily rations.

(r) Water is a great difficulty. Wagon lines are ordered not to advance beyond the river ANCRE which is 1500 yards inside our lines. For some time petrol tins have been collected and each lorry or ammunition wagon coming up to the batteries brings up two petrol tins full and takes back two empty ones. When the advance takes place, full petrol tins will have to be taken forward and all water in the enemy lines will be examined and treated before being used.

Communications.

8. During the advance the infantry all along the line will burn red flares at stated times to show their position. Every imaginable scheme for signalling both to aeroplanes and also to the main O.P's and so back is being tried, especially shutters and searchlights. Codes have been arranged as the former are very slow in working.

Air Service.

9. Probably two wireless aeroplanes will be up per Corps and these are protected by contact squadrons. The planes in the different Corps are tuned to very different wave lengths to avoid jamming. No one either of Heavy or Divisional Artillery was met with a good word for the balloons, except that they made the enemy nervous. They will only be used for general observation.

Trench Mortars

10. The medium. This will be used to cut wire & parapets wherever they can reach them, practically about 2/3 of front line but very little support line. It is not considered practicable to take them and their ammunition forward in the advance. All the Stokes mortars will be taken and slings to carry their bombs have been made which enable

a man to carry all his equipment and also 6, one sling over each shoulder and one round the neck.

10 extra 2" batteries and 8 extra Stokes batteries are with the Corps and they have 500 rounds a mortar in addition to their usual establishment. The medium T.Ms are in a hole 12 feet deep and have ample dug-out accommodation for men and ammunition well underground. The Heavy T.Ms are about 25 feet down in enormous emplacements on the principle of the French design.

Trench Guns.

11. There is only one Trench gun on -- Division front to deal with an awkward salient and afterwards a communication trench which it enfilades. It is some 2-300 yards behind the front line, well dug in.

Wire Cutting

12. The -- Division has worked out that if it is to cut all the wire within 3500 yards, 70,000 rounds will be necessary, this is prohibitive. It is therefore essential for the infantry to state what wire can be left. The 60 pdrs are supposed to cut these lines of wire at ranges from 5000 to 7000 yards. They will try to cut a few lines, using two shrapnel to one H.E., but favourable results are not anticipated.

Observation Posts.

13. The O.Ps seen were nothing to buck about. It has been recognised that concealment is better than protection and the roofs are only splinter proof—in one case iron rails placed close with a few inches all over. Nearly all except those in front trenches were along a trench giving excellent view along the ridge of a hill. Telephone dug-outs went down opposite these and gave ample cover. There is a bullet proof mushroom topped concrete moveable O.P. for use in front trenches but it was not seen. In one or two cases the observer is well underground with a periscope but this did not appear to be very satisfactory or necessary. All lines to O.Ps were laid by Division or Corps Signals, buried 6 ft. and orders were given that no extra lines were to be made. These orders are more honoured in the breach than in the observance, as batteries which have wire prefer to run them direct to avoid the Exchange and the hearing of other batteries connections. When these private wires were run they were also buried 6 ft. but the trench was open, which appears to have advantages. The supply of wire is scarce, all units have orders to take forward their full equipment, so that it is only the pinchers who have been able to run private wires.

General Scheme of Attack

14. (s) There will be 5 days wire cutting combined with bombardment before the actual assault. Generally speaking some three hours are given for wire cutting in the morning and perhaps another three hours in the afternoon. Maps are divided up into

uneven areas, corresponding roughly to groups of trenches, and lettered, and Divisions are asked in which they propose to cut wire. Suppose they say H & P Sections; the deliberate bombardment of trenches by the heavies is kept off those sections.

(t) Owing to the great number of trenches which have to be done in, Divisions - not C.R.As Divisions, are told that it is impossible to do in any trench twice deliberately and that it is up to them to prevent them being repaired by every means which is available.

(u) The first arrangements for the bombardment are made out by the Army, which taking three or four successive lines roughly parallel to the front line gives, after consultation with the Corps, the times at which the infantry must have arrived at those lines. The G.O.C. R.A. Corps then places subsidiary lines and the GS give the times at which the infantry may be expected to reach them. All these times are the times they must be reached, they may reach successive lines earlier, but, if possible must not start from them earlier than the times noted. The barrage in front will however check undue haste. Generally speaking this barrage is about 800 yards deep and consists of first Divisional Artillery, the 6" hows., then heavy hows., the special heavy hows being on selected targets not connected with the barrage. When the successive lifts occur, heavies lift at once to next line, Divisional Artillery creeps back. All batteries of each nature are given straight lifts so that there is practically no switching and, though the lifts as far as possible follow the lines of trenches, in places they go across the open country. Deliberate observation is of course impossible during the set bombardments; batteries should, keeping as far as they can the line of the trench, search the length of their 50% zone over and short of it, so that all the ground is fairly plastered with fire. During the set bombardments on the days prior to Z the same lifts are always practised though sometimes the 4th or 5th line is started on instead of the first and the times of the lifts are varied, also at times the full width is not taken up. These set bombardments vary from 40 minutes to 1 hour 25 minutes and there are from one to three a day, rate of fire usually one round per gun per two minutes. Villages are dealt with one day by every available gun and howitzer firing rapidly for 12 minutes, field guns with shrapnel, and later the field guns again rain shrapnel on them for a short time. A concealed valley is searched for 40 minutes one day by all available howitzers. Every night and during set bombardments all approaches are searched by heavy shrapnel in the distance, and by 18 pdr. shrapnel along all near communication trenches. On one day there is a concentration of fire on all known battery positions, but to avoid giving away the number of batteries all do not open. For the same reason all the T.Ms. should not cut wire together. On Z day the final objective is reached and there is about 400 to 500 [yards] in front a strong trench on to which the barrage is lifted whilst the objective is consolidated. At a fixed time, the barrage is lifted in certain sections and patrols go forward to see if the trench is occupied. If it is not occupied we take it and have succeeded in breaking through the line.

(v) The batteries which are most suitably placed do in the trenches during the deliberate bombardments and not necessarily the batteries in whose straight bombardment area these trenches are. Special groups are formed for enfilading under the G.O.C.,H.A., Reserve Corps. During the bombardment immediately prior to the assault (1 hour) the strong places are specially treated, arrangements being made to bring all batteries into their correct line just prior to the assault. During these preliminary days, raids with or without gas are constantly tried. Officers are specially told off during the set bombardments to watch the general effect and evenness of the lifts.

Notes.

15. (w) There must be the strictest censorship of all letters from the moment that operations start.

(x) Battery commanders must see to the training of the loading muscles and strict attention to the details of drill, especially in the case of new batteries. Also drill must be practised with gas helmets on.

(y) Lanes between guns for Divisions moving through the lines must be carefully marked out to prevent the fire of the batteries being masked.

(z) If a new battery comes in at the last moment some trained personnel of all ranks from the old batteries must be settled beforehand to attach to them in order to stiffen them up.

(aa) Hours of official night must be arranged.

(ab) Captured guns must be brought back, as early as possible, by Ammunition wagons returning empty.

(ac) When registering targets, if ammunition is available, some rounds for effect should always be fired.

(ad) Every battery should have a datum point, the ground line of which can be seen, and after registering, a few rounds should be fired on this datum point to find the true error of the day and so find out errors in the days corrections.

(ae) 12" and 15" howitzers in the Fourth Army do not commence registration or firing until the first day of preliminary bombardment.

(af) Some spare platforms for 9.2" hows. should be laid well forward.

(ag) All roads where anything can be seen from the enemy's lines should be well screened and to prevent espionage, all batteries which are against high roads.

(ah) It is all important that a very large dump of material should be started as early as possible, owing to the great difficulty in collecting necessaries at a late hour. Steel cupolas, galvanized iron, heavy pit-props, rabbit wire, camouflage grass, green paint, boards, concrete, bricks, iron rails and speaking tubes are all wanted in unexpected amounts.

(ai) A large number of 1/5000 maps are essential for the whole area with which Corps are interested. These should not be small size.

(aj) One topographer is attached to the Heavy Artillery of each Corps from the commencement of operations to make out planchette boards for any new positions taken up by the Heavy Artillery. No attempt is to be made to supply boards for the Divisional Artillery, until the Heavy Artillery is satisfied.

Camouflage.

16. Camouflage is much used in the Fourth Army and is invaluable for purposes of concealment. Rabbit wire with a little camouflage grass tucked in here and there is the best. It is no use putting it flat on the ground, it must be raised some feet on posts. To avoid shadows the wire should be sloped away from the top of a gun emplacement & all trenches (which cast very decided shadows) should be screened by strips of camouflage wire. The wire must be of open mesh, nothing is worse than one thing which is seen, viz: — pieces of close meshed iron for reinforcing concrete, with a few bits of grass tucked in. The open coir matting is good for sides of guns, etc., but no use for overhead cover.

Protection.

17. It is no use comparing the protection which can be obtained for battery positions in the dry chalk of the Fourth Army, with the clay here, but the amount of protection varied much in the different batteries, and some notes are appended as to what has been done.

(ak) Generally speaking the Field Artillery gun-pits had 5 ft. of cover overhead consisting of pit-props or rails about 2 ft. apart, galvanized iron, two rows of sandbags filled with chalk soil, soil, & burster of concrete slabs or stones, some soil & turf on top. Some 250 to 350 cartridges and shell were arranged in the walls in the gun pits. From one corner of the pits stops went down to a store at least 8 ft. below the surface with 8 ft. of cover made as above described. A deep trench was common along the back of the position which led to magazines in rear of either flank of the battery with 10 to 12 ft. of cover overhead. Sometimes there was 1 to 2 ft. of airspacing between two roofs. In two cases there was a telephone dug-out tunnelled 20 ft. below the surface.

(al) Siege batteries varied very much. Except in the case of two 6" batteries which had been established about two months, the cover was almost invariably camouflage only. Most of the batteries were dug into banks, and a wall of sand-bags one stretcher and one header thick was built up behind them under the camouflage. 10th Siege Battery which may be taken as a representative 9.2" battery, was in an orchard, the howitzers were sited irregularly under low trees with camouflage over them. Deep trenches, very narrow, were cut on either side of the howitzers, which led to magazines for the cartridges, 14 ft. below the surface, 10 ft. by 9 ft. by 6 ft. high with 12 ft. of cover overhead. These magazines should be dug out and the roof then put on—not tunnelled—and 10 men can make one in three days, making their own concrete for bursters. Concrete slabs make the best bursters.

Dug-outs for the men to live in and for protection were tunnelled into a sloping bank at the back of the orchard. Six hundred shell were arranged in rows, a sandbag between each shell, on the slopes of the orchard and covered with grass, so arranged that they could be rolled on boards down to the gun in turn. A high screen had been erected between the high road and the battery. One section had been in position 14 days and one section 4 days and the work was practically complete. All dug-outs should have two entrances, one being turfed over to prevent gas entering and the other having the usual gas blankets.

(am)The heavy batteries had either camouflage or splinter proof cover over them. They had, generally speaking, not been very long in position, and the magazines and dugouts for the men were not always as finished as the one above described. As these batteries may often be moved into forward Divisional Artillery positions, when the latter advance, it is well that the gun-pits of the most advanced Field Artillery batteries should be made big enough to take a 60 pdr.

Dumps.

18. The Divisional Artillery arrangements have been already described.

(an) In the case of the Siege and Heavy batteries it was almost always possible to make magazines with ample bomb proof cover either sunk in the ground, in banks, or in the cellars of houses with deep piles of sandbags over them and entrances out through the walls leading into deep trenches which led to the gun-pits.

(ao) In the case of shell it is obviously impossible to provide bomb-proof cover and in the III Corps area, the methods of dumping were very varied. In one Group the heavy shell appeared to be crowded all together as close to the gun pits and in them as possible. The Group Commander was gambling on the fact that he had had three 9.2" shell hit directly by 5.9s and that the walls only had been split, no detonations occurring. The labour of supply was of course reduced but the system is too dangerous to be advocated. In several cases, as already described lanes of projectiles with filled sandbags between each were caused all over the field. One 6" battery had the shell in lots of about 30 behind a wall, with traverses out 3 ft. wide of sandbags between the lots. Where slopes were available in one or two cases shell were in trenches, cut rather like a field kitchen, behind the gun. One trench on the arc of a circle and radiating from it three trenches converging to a point at the gun, the shell being rolled down these trenches in turn with no labour. In some cases the shell were in long lines nose to base in the open. What appeared for general use the best method was used in Captain Cream's 8" battery. A trench about 5 ft. deep was cut under some bushes about 20 yards behind the battery. Shell was standing in this trench, lots of about 20 separated, they were washed in the trench and then sand-bags put over them - a most valuable idea for preventing dirt again getting on in rolling them up to the gun. Behind each gun was a 14 ft. lever pivoted on a stand with a small rough iron tray pivoted on the point. The small end of the lever being raised a shell in sand-bag was rolled on to the tray, small end lowered, and the shell brought up level with the ground, tray swivelled, and shell rolled off on to a board and rolled up to the gun-pit. Supply as rapid as the gun could be fired and no labour

15: Artillery Notes Number 5, Wire Cutting, June 1916

Issued by the General Staff at General Headquarters
Source: IWM SS/CDS Pamphlets collection

I. WEAPONS FOR WIRE-CUTTING.

1. The weapons for wire-cutting are:

Medium Trench Mortar.
18-pr. Q.F.
Howitzers.
60-pr. B.L.

In all cases close observation is essential to obtain good results.

TRENCH MORTARS.

2" Trench Mortar.

2. The 2" Trench Mortar with the Newton fuze has been found the most suitable mortar for wire-cutting, for the following reasons :

a. The bomb contains sufficient weight of metal to cut the wire.
b. The H.E. charge is sufficient to drive the fragments at a high velocity through the wire.
c. The bomb bursts immediately on impact, so the lateral effect is very great and the craters formed are small and shallow.

Effect with 2" Trench Mortar.

3. The following experiments have been carried out, which show the results that may be expected when using the 2-in. Mortar with Newton fuze:

d. The wire consisted of a mixture of English and French barbed wire, strung with the least possible tension from wooden pickets about 4 ft. high. Each bay was 12 sq. yds. with 12 strands to each bay. Forty rounds were fired, of which 30 fell in the wire itself, and 1,200 sq. yds. were cut sufficiently to allow the easy passage of infantry. This is at the rate of one round per 40 sq. yds.
e. The target consisted of crinoline wire crossed by strands of barbed wire. Forty rounds were fired, of which 25 fell in the wire itself, completely demolishing an area of 600 sq. yds. This is at the rate of 1 round per 24 sq. yds. The range was about 333 yards and the conditions easy.

From these experiments it would appear that one round per 10 sq. yds. of barbed wire, and one round per 6 sq. yds. of loose wire, would be a generous allowance when estimating the amount of ammunition required to cut wire with the 2-in. Trench Mortar, using the 107 D.A. fuze, and allowing a factor of safety of 4 for difficult conditions of firing, observation, etc.

Observation of Fire. 4. Observation of rounds against wire is difficult, and flank observation should invariably be employed if the best results are to be obtained. Wind will be found to have considerable effect on 2-in. bombs, so that in windy weather very careful observation and ranging is necessary.

III. 18-pr. Q.F.

Range. 5. The best ranges for the 18-pr. are between 1,800 and 2,400 yards. Between 1,000 and 1,800 yards difficulties generally occur in clearing our own parapets, owing to the flat trajectory of the shell, and below 1,000 yards fuzes cannot be set to burn with sufficient regularity on account of its high velocity.

Wire can be cut up to about 3,500 yards, but more time and a considerable increase in the amount of ammunition are required. Above this range the shrapnel bullets have not sufficient remaining velocity to deal with wire effectively.

Calibration. 6. Guns must be overhauled by the artificers and carefully calibrated before being used for wire-cutting.

Platforms. 7. Good steady platforms are essential. The best platform has been found to consist of a foundation of brick, or sandbags with a covering of brick rubble, well pounded—wood is too springy. On chalky soil a special platform has been found unnecessary. A baulk of timber should be placed under the trail-eye and sandbags placed between the baulk and the spade. For accurate shooting the gun should recoil in prolongation of the trail, as jump and side-slip are then practically eliminated. To obtain this at the shorter ranges the trail should be raised and well supported in such a position that the gun has a little more than the correct elevation when it is in the travelling position. Steps for the trail can be cut to suit varying elevations if required. The traversing gear should be nearly at zero for the same reason.

Anchoring. 8. With a good platform and the gun recoiling in prolongation of the trail, anchoring is often unnecessary—sandbags placed behind and in front of the wheels, and on the lower felloes between the spokes, will help to steady the gun.

If anchoring is necessary, a baulk of timber should be well dug in directly under the axle and secured; a rope being passed round it and round the trail as far forward as possible. The recoil of the carriage tightens up the rope. When a switch is required, it is only necessary to run up the gun, and the rope slacks off.

Observation of Fire. 9. The observing officer should be as close as possible to the wire and his eye should be on a level with his task. It is generally advisable to have two observers—one close up and to a flank to observe for range and height of burst, one further in rear and directly opposite the wire to correct for line. This is especially desirable when firing at wire in enfilade. It may some-times be necessary to make special arrangements for close observation, e.g., by sapping forward and establishing an observing station.

Before guns attempt to cut wire, infantry patrols should be sent out to report on the nature and extent of the wire, looking especially for low trip wires where the grass is long. They should also report on the progress of destruction. In the case of distant hidden wire, it may be necessary to resort to air photographs to obtain this information.

Ranging. 10. It is generally agreed that shrapnel is the most efficient projectile, but everything depends upon bursting the shell in the right place. Each gun should be accurately ranged on the near edge of the entanglement and the shell should burst about four feet above the ground and as close to the wire as possible. A burst even five yards short has little effect.

Instead of using the corrector, the length of fuze should be given, and small alterations in the height of burst obtained by raising or lowering the angle of sight a few minutes. About 30 to 40 per cent. of the rounds should burst on graze.

A proportion of H.E. shell (about 5 per cent.) mixed with the shrapnel is useful when the wire is fixed on iron posts.

Method of Fire. 11. When plenty of time is available, a good method is to begin with two or three guns per battery and note which gun settles down to steady shooting. Continue with that gun, relieving the detachments. A gap should be made through the wire and then enlarged.

When there is a large amount of wire to be cut, each gun should be ranged separately, and then fire continued with salvoes, gradually reducing the elevation as the guns get hot. Continual pauses must be made to let the guns cool down and to check the registration.

Once a battery has been detailed for wire-cutting, it should not be called upon to fire at other targets except in case of emergency. Night-firing, barrages, etc., should be carried out by other batteries.

Ammunition. 12. The amount of ammunition required varies with the range and the depth and quality of the wire. A rough rule is to allow 1/3 the number of hundreds of yards in the range for each yard of front.

The ammunition required should be dumped beforehand as far as possible, so as to avoid throwing unnecessary strain on the personnel of the battery. Fuzes should be sorted into "lots." Fuzes vary, and occasionally a good "lot" will burn very regularly and allow of a reduction in the number of grazes expected.

IV. HOWITZERS.

High explosives from howitzers (4.5-in. and 6-in.) should be used in conjunction with the 18-prs., to scatter the posts and the wire when cut. Heavy howitzer (8-in. and 9.2-in.) will cut a lot of wire, but unless a quick acting fuze is employed (such as No. 106), they are liable to create awkward obstacles, owing to the size of the craters.

V. 60-pr.

Wire beyond the range of field guns may be cut by 60-prs., provided accurate observation is obtainable, but the amount of ammunition required is very large. H.E. may be employed, but only a small portion of rounds can be expected to burst in the wire. The difficulty with shrapnel at long ranges is the irregular burning of the time fuze (No. 85); but this may be improved by taking out the set-screw, loosening the nut, setting the fuze and then tightening up the nut again. The set-screw is then replaced.

A good steady platform is a necessity. The trail should be raised above the level of the bottom of the wheels and the carriage allowed to recoil through about 2 feet

16: Letters from Major General Birch, June-July 1916

urce: Uniacke Papers, RAI, U/III/13

General Head Quarters
British Armies in France
9th August, 1916.

The Secretary,
Royal Artillery Institution,
Woolwich.

Sir,

The two papers attached are sent to you privately [holograph replacement: for acknowledgement please]. They deal with the control and command of the artillery of higher formations, and with the status of the Artillery Commanders of Corps and Armies.

It is thought that, should the further history of the Royal Regiment ever be written and its direction in this war be described, these papers might be of considerable interest. They are forwarded not for present day publication but solely for the purpose

stated.

Kindly acknowledge receipt.

Yours sincerely,
Noel Birch

C.G.S.

1. From interviews with various artillery commanders and from the notes left behind by my predecessor on the action of our artillery during the German attack on the VIMY RIDGE, I am led to believe that the fighting efficiency of the artillery could be very much improved if the General Staff issued instructions which would more clearly define the duties of the various grades of higher command in the artillery.
2. I have no doubt in my mind that in many cases senior artillery officers neither exercise command nor regulate the work of the artillery as they should nor are they allowed in some cases to take up the necessary position in order to perform their duties efficiently. The longer this War continues, the greater the supervision and

guidance required from the higher ranks.

3. I am strongly of opinion that the B.G.R.A. of the Corps and the M.G.R.A. of the Army should be in the same position with regard to their respective commanders of formations as the B.G.R.A. of the division is with regard to his general. The ever increasing amount of heavy artillery in the firing line has altered war conditions. The G.O.C. of the Army and the G.O.C. of the Corps must of course command their own artillery, but they must have the instrument and necessary machinery to do so.

4. In O.B./446 dated 23rd October 1915, the status of Artillery Adviser with the headquarters of a Corps was altered; he was appointed G.O.C. the artillery of the Corps, and given the executive command of such portion of the artillery in the Corps that the Corps Commander might from time to time direct.

5. There were then three Armies in existence, and each Army interpreted the letter quoted in the preceding paragraph differently. In the First Army the G.O.C., R.A. of Corps formed his heavy artillery into group or groups and took executive command of group commanders. In the Second Army the heavy howitzers were given to Corps, but the 60-pdrs. were retained for counter-battery work under the Army. In the Third Army the 60-pdrs. were given to Corps to carry out counter-battery work, but the heavy howitzers remained under Army direction, that is to say, that in the First Army the combination of weapons necessary for efficient counter-battery work were in the hands of Corps, whilst in the other two the weapons were divided between the Army and the Corps. In O.B./446 dated 29th March 1916, the status of the G.O.C., R.A. of the Corps was again altered. He became "Brigadier-General R.A. of the Corps", was robbed of all executive command, and given a position analogous to that of the M.G.R.A. in the Army. In O.B./446 dated 7th May, 1916, his duties were again defined, but not, I consider, satisfactorily. The Commander of the Corps Heavy Artillery should have been placed directly under his command.

6. I recommend that the B.G.R.A. of the Corps should again be styled the G.O.C., R.A. of the Corps; that he should be absolutely responsible to his Corps Commander for the efficiency of the whole of the Artillery in the Corps; that he should co-ordinate the action of the Artillery both in offensive and defensive action—the necessary instructions being issued direct to the Commander of the Heavy Artillery, but through the General Staff of the Corps in the case of the Divisional Artillery; and that he should take executive command of any concentration of Corps and Divisional Artillery at the direction of the Corps Commander. From experience gained as a G.O.C., R.A. of a Corps, I know that all this can be done with an entire absence of friction, and without taking away from the Divisional General the responsibility for the defence of any portion of the line.

7. I further recommend that the M.G.R.A., or Artillery Adviser, of the Army be made the G.O.C. of the Artillery of the Army, that he be made responsible to the Army Commander for the efficient conduct of the Artillery of the Army, and that he be given the power to take executive command of any concentration of Artillery that the Army Commander may see fit to make. It should be his duty when his Army Commander directs to carefully examine all offensive and defensive artillery plans made by Corps and, if the whole Army takes the offensive, to draw up the artillery plan. Unless actually in executive command, his instructions should be issued by the

General Staff.

(sd) Noel Birch,
Major General.
A .A.,
G.H.Q.
8th June, 1916

C.G.S.

At your request I send in the following note. I consider that at present there are too many people mixed up with the gun and ammunition question (both fighting and supply) at G.H.Q., and that it would be better to inaugurate a system which would place the whole business under one man, who would deal directly with you and the General Staff. At present the following people deal with guns and ammunition:

> With due respect, I believe you have written private letters on the subject.
>
> The Deputy Chief of the Staff writes a great many official letters.
>
> O.A. and O.B. both take a hand in the business.
>
> The Quartermaster General telegraphs home when certain classes of ammunition are running short.
>
> The Director of Ordnance Services deals with certain technical questions, which also affect the supply at the front.
>
> The Artillery Adviser tries to help everybody with his advice, if they have time to ask for it and desire it: any decision that he may give on the points raised is not, of course, in any way authoritive.

What the General Staff at G.H.Q. want is a machinery which will make the most of the fighting power of their guns and ammunition in the simplest way and without hitch. With this ever increasing supply of artillery have they got it and, if not, would they have it if they made the Artillery Office at G.H.Q. a fighting branch of their Staff?

It is interesting to trace the growth of relations between the Artillery and the General Staff during the last two years throughout the Expeditionary Force in France. Great opposition was first raised as far as the Army was concerned. What has happened since? The Army Artillery Adviser, though it is distinctly laid down that he is neither a Staff Officer nor a Commander, has become a fighting officer, and has had to assume a position that he was never intended for by the General Staff and is not entitled to. He allots his guns, controls his ammunition, supervises the artillery fights, counter battery areas, &c. Some Corps Artillery Commanders had already assumed these duties. I do not say that this innovation has been brought about without difficulties and misunderstandings, because to a great extent it has come into being through the personality of individuals (Army Commanders, Corps Commanders, Artillery Commanders) and not from G.H.Q. direction. When in any formation—Army or Corps—the lead has not been given from above, the Artillery results have been bad.

Do you intend to recognise the state of affairs that now obtain in the Fourth and Reserve Armies, and I believe in the Third Army, which has come about as a fighting necessity? If you do, I think you should issue instructions on the subject to bring other Armies and Corps into line, and also reconsider the machinery of the General Staff at G.H.Q. In my opinion no General Staff, except a Divisional one, is now officially constituted to fight a battle under the conditions obtaining, and the Army and Corps Staff would be very much strengthened by the addition of a recognised artillery machine. In fact the whole situation of the relations between the General Staff and the Artillery, from G.H.Q. to the Corps, wants reviewing in the light of recent experience and future necessity.

It is high time that the "bogey" dual control was knocked on the head. The Artillery Command throughout requires strengthening to prevent dual control in action, and to ensure rapid and efficient concentration of fire, efficient co-operation with aeroplanes , etc.

Witness the organization of the Flying Corps built up on the experience of this War. Nobody can say that there is friction because Brigades are under the G.O.C. Flying Corps as well as under the Armies; and it is worth noting that the Brigade Commander cannot do his work with the Artillery efficiently unless the Army Artillery Adviser is a commander.

(sd) Noel Birch,
Major General.
A .A.,
G.H.Q.
29th. July, 1916

17: Birch's report on the Somme Bombardment, 9 July 1916

Source: Rawlins Papers, RAI, file 12a

C.G.S.

1

It appears now that there are sufficient data available to discuss the employment of heavy artillery on the British front with regard to future action and in the light of French experiences. There seems to be a general impression that the value of concentration of fire has not been sufficiently appreciated in the British Army.

It will be convenient to first take the disposition of the Artillery for attack before these operations commenced. There is no doubt that if the Artillery—and the Artillery alone—had been consulted and asked how much Artillery was necessary to attack the front in question they would have said one howitzer, 6-inch or over, for every 50 yards for destructive purposes only; our Northern limit of attack would then have been about LA BOISSELLE with the number of howitzers available. Presuming that this view had been accepted and that the German defences had been totally demolished—as doubtless they would have been—I do not consider that we should have been in a better position today, in fact not so good. The concentration of German Artillery against this limited front would have been terrific—our attack had been so well advertised in advance.

From results of the attack as it was carried out I do not consider that we are justified in assuming that the greater part of the Artillery should be massed on salients and the intervening spaces neglected, presuming that the Infantry are to advance against the intervening spaces. There is no doubt in my mind that the surest way to success is to follow the system adopted by the French, and that is practically to blot out the whole of the enemy's defences on the front of attack before the infantry are launched. If the intervening spaces between salients are treated lightly our infantry must be in trenches close enough to the enemy to enable them to jump into the enemy's trenches before he has time to bring his maxims out of his dug-outs and man his parapets (see report of damage to XV Corps front defences). So much for operations against well fortified positions. A second phase in the operations is now in progress, and strong points between the Germans' first line and second line must and will be treated with the greatest concentration of fire possible. When these points, now occupied by the enemy, are cleared, the question of attacking the second line must be considered; and I am of opinion that the whole of the second line defence system to be attacked, and at least 1,000 yards on each flank of it, should be demolished before the Infantry its asked to assault.

The conditions from the first attack are perfectly different. We have gained the advantage of dispersion on a long front. This has enabled us to reach the second line. We must make absolutely certain of getting through. This will not be done by extreme concentration on salients and neglect of intervening spaces, unless the salients alone are to be seized first and the remainder of front kept under strong fire.

Major General,

A.A.,
Adv. G.H.Q,.
9th July, 1916

18: Artillery Lessons Drawn From The Battle Of The Somme, c. December 1916

Source: Montgomery-Massingberd Papers, LHCMA, file 7/4.

I. The Artillery plan of action may be considered under three headings.

A. G.H.Q.

The allotment by G.H.Q. of Guns and Ammunition to Armies is the determining factor in the scope and general policy of the Artillery Operations to be undertaken.

In order to maintain the allotted Artillery at its full fighting strength it is essential to provide initially and continually for spare: Officers—Men—Equipment of all kinds—Ammunition and Stores.

It is not sufficient that these should be available at the Base: they should be near the Battlefield and ready to replace personnel or material temporarily or permanently out of action.

Artillery co-operation between Armies must often be a matter for G.H.Q.

B. The Army.

The Army deals with:

1. The distribution and employment of the Artillery on the Army Front viewed as a whole.
2. Artillery co-operation with Armies on the flanks and between Corps.

These include:

- a. The general direction of the preparatory arrangements connected with Artillery positions, observing stations, communications, equipment and ammunition, including their concealment and protection.
- b. The general determination and guidance of the Artillery policy, more especially in relation to:
  - i. Counter-battery work.
  - ii. Night-firing.
  - iii. "Long-range" Gun work.
  - iv. Enfilade Fire and Concentrations of Fire.
  - v. Employment of Anti-aircraft guns.

Before adopting any offensive policy our means and determination to carry it out must be carefully weighed against those of the enemy.

A policy once adopted should be pursued with relentless vigour; half measures generally serve only to stir up retaliation.

c. The nature and duration of preparatory bombardments.
d. The most effective methods to employ in the attack.

C. The Corps.

In large operations the plan of action must be a "Corps" plan, built upon the foundations laid by the Army.

This does not and should not prevent a thorough system of decentralisation such as to permit the Artillery Commanders of subordinate formations full latitude in the detailed arrangements for the executions of their tasks.

The Corps plan must ensure thorough co-operation between, and the best use being made of, Field and Heavy Artillery and of Trench Mortars.

No tampering with the general artillery policy and plan of action, once they are formed, should be permitted, except for strong reasons, and only then with due authority.

There are two points to which the greatest importance is to be attached:

1. he plan of action being based on information derived from all available sources, such as Reports of "Intelligence" of Army, Corps, and Divisions; Reports of Artillery and Aeroplane Reconnaissance; Cross-examination of Prisoners; Study of Maps and Photographs. The G.O.C., R.A. Corps must moreover remain in close touch with the situation on the front.
2. Subordinate formations and units being afforded ample time to study and work out their tasks in detail.

II. Organisation.

D. Field Artillery.

The initial organization remains that of the Division.

In large operations, however, a Divisional Artillery is inadequate to cover a Divisional front.

It is difficult to lay down any limit to the number of guns which can be employed usefully to ensure success, and a proportion (15 to 20 per cent.) of those available may be reckoned as non-effective at any time after the commencement of Operations, owing to various causes, such as wear, prematures, hostile fire and defects.

Infantry require to be relieved long before the Artillery does so, and constant changes in the Artillery and its command are not conducive to effective work.

Consequently, in large operations, we must regard the Field Artillery rather as large Groups covering individual Divisional Fronts than as Divisional Artilleries. This does not alter the fact that it is distinctly advantageous that Divisions should be supported by their own Divisional Artilleries, under the command of their own C.R.A's, if this ideal can be attained.

It is hoped that the formation of Army Field Artillery Brigades may conduce to this.

E. Heavy Artillery.

The Grouping of the Heavy Artillery should facilitate:

1. Co-operation with Divisions in the bombardment of the hostile front defensive system.
2. Effective Counter-battery work.
3. Effective work by guns of long range.
4. The quick and smooth reinforcement of Bombardment or Counter-battery Groups, or of the Artillery of other Corps.

To attain these results, Fourth Army experience has been that the Heavy Artillery of Corps should be organized into:

5. Heavy Artillery Divisional Groups remaining under the command of the B.G., H.A., but with the Group Commander in close touch with the Division to which his Group is affiliated.
6. Two Counter-battery Groups—one of Guns and one of Howitzers—or of mixed Guns and Howitzers, according to local circumstances.
7. A "Long-range" Gun Group.
8. One or more Reinforcing Groups, containing Guns as well as Howitzers.

The siting and arcs of fire of these Groups should be in accordance with their tasks.

The organization in all Corps should be similar. Stress is laid on the importance of the existence of this or some similar organization in an Army.

It facilitates effective co-operation between Corps and the smooth and rapid re-allotment of Artillery on the Army front according to the tactical situation. Moreover, it promotes clear views on the employment of the Artillery and facilitates their being put into execution.

III. Preliminary Arrangements.

The experiences of the Battle of the Somme have served merely to accentuate the importance of:

F. Concealment of gun positions and observing stations, and of providing secure protection for the Personnel and Ammunition.

The necessity for concealment has increased the importance of Camouflage.

Bomb-proof cover for the Observing Party near the O.P. and for the Detachments and Ammunition near the guns has been rendered all the more necessary by the development of hostile night-firing and the large amount of ammunition which it is now necessary to maintain at the gun position. Whether overhead gun cover is requisite or not depends on local circumstances and should be subject to the preservation of concealment.

As a rule, splinter-proof cover justifies itself for Field Guns—but the provision of enormous quantities of material for the overhead protection of Heavy Howitzers or Guns in positions outside the normal shell zone is not justified.

G. The protection of telephone communications and provision of good communications with Observing Stations.

These demand the labour of many men and is work which should be undertaken early as being essential to Artillery operations.

It is advisable to bury the telephone wire from front to rear, to ensure at an early date secure communication in the more exposed areas.

H. The establishment of roads and railways to facilitate Ammunition Supply.

Every unit should be fed by Decauville Railway [a narrow gauge railway]—it is important to keep horses and wagon lines generally as much out of the shell zone as possible and reduce what must in any case be abnormal traffic on the roads.

IV. Counter-Battery Work.

The destruction of hostile batteries by Artillery fire demands great accuracy of fire and considerable expenditure of Ammunition.

These again demand time, aeroplane observation and favourable weather.

Long before the day of assault we must therefore commence the steady methodical destruction of the enemy's artillery with the object of reducing his available strength on the day of battle.

Every favourable opportunity must be seized to carry out destructive shoots with Heavy Howitzers and aeroplane observation. If a Battery can be located, destroy it; the chance may never recur.

Nothing must permit us to be deflected from the pursuit of our object. This is easy to say, but there are two tempters ever on the prowl to lead us away from our quarry. The first is the employment of the Counter-battery Heavy Howitzers for other tasks, and the second is the employment of the Counter-battery aeroplanes for bombing enterprises and Trench shoots.

A daily record should be kept of all Counter-battery shoots carried out with aeroplane observation, successes and causes of failures being noted carefully.

Up to the moment of the Assault it is a question of how many guns we can destroy.

From the moment of the Assault, it becomes a question of neutralizing the fire of all those Batteries which we have not succeeded in destroying. For the time being, slow, methodical and accurate fire is neither feasible nor effective.

Our plan for the neutralization of all batteries known, or suspected as likely to be active, must have been in preparation for weeks past, based on constant observation and information and revised up to the moment of the Assault.

All available Guns and Howitzers must be employed for the purpose. It has been found by experience that very soon after the Assault takes place, Aeroplane Observers are able to communicate information, permitting the Counter-battery fire, which has been fully developed at the moment of the Assault, to be modified and corrected.

Kite Balloon Observers are not so well placed as are Aeroplane Observers for carrying out Counter-battery work, and although they have demonstrated their value in this respect, as a rule they are better employed in watching and aiding Artillery in dealing with hostile movements, thus also permitting the aeroplanes to concentrate more of their attention on Counter-battery work.

V. Night Firing.

The experiences of the Battle of the Somme have confirmed those of the Battle of Loos on the great value of night firing.

It is by night that almost all German movement and work in the front line systems is carried out.

The object of night-firing is to render the relief of troops, the supply of ammunition and food, the movement of guns, and work of all kinds—if not impossible, at any rate, a hazardous and expensive business.

The effect of night-firing is, moreover, most demoralizing to the enemy—prevents information being obtained and the systematic organization of counter-attacks and generally serves to keep the battle "open."

It leads to retaliation, but forms part of the struggle in which we must establish our superiority in order to ensure victory.

It is most dangerous to allow local circumstances to over-ride the carrying out of this night-firing policy.

During the Battle of the Somme, a Division succeeded in stopping night-firing on its front in order to facilitate its preparations for attack. The Germans kindly ceased firing on the front concerned. The Division attacked in the early morning, only to find that the Germans had constructed new defences and repaired their wire, with the result that the attack failed with considerable loss.

Great stress is to be placed on the system of night-firing being decentralised. Tasks should be allotted to subordinate formations, who should base their plans on information derived from the study of maps and photos, and from prisoners' reports, etc. etc.

It is during the night, in preliminary operations, that the Field Artillery, and certain units of Heavy Artillery, are required to display their greatest activity.

Stress is laid on the necessity for a well thought-out system of relief amongst the personnel of units, and for guarding against any "closed time" such as is liable to occur in the early hours of the morning, and of which advantage is certain to be taken by the enemy.

VI. Long-range Gun Group.

The principal tasks of "long-range" guns are the enfilading of parts of the hostile defensive system, denied to guns of lesser range, and the systematic attack of the rear defensive system.

The latter task includes the attack of Kite Balloons, Ammunition Dumps, Railheads, and Billets.

It follows that the employment of these guns directly concerns the Army, and their effective use is much facilitated by their organization in special Groups.

A special plan should be drawn up for their employment on the day of battle—a plan somewhat similar in its nature to that of the Counter-batteries, but dealing with distant approaches, etc., and equally dependant on thorough co-operation with the Flying Corps.

VII. Enfilade Fire and Concentrations of Fire.

The two great factors in an Artillery plan of action, given a reasonable number of guns and adequate ammunition, are the possibilities of Enfilade fire and Concentrations of fire.

Their presence renders a plan a "good proposition" and in conjunction with "our" Infantry spells success. In their absence, success is not likely to be obtained without heavy loss.

The famous attack on the Bazentin Ridge on July 14th, constituting as it did a most difficult operation, from an Infantry point of view, was redeemed by the possibilities of artillery enfilade and concentrated fire.

The capture of Delville Wood on July 27th, was rendered a certainty by the enormous concentration of guns—1 Gun to three yards—the Infantry assaulting under a barrage fire from over 200 Field Guns on a comparatively narrow front.

The difficulties of concentrating artillery fire, and the absence of all enfilade fire, on Guillemont of themselves rendered the capture of this place a most difficult proposition.

The importance of these two factors must therefore never be lost sight of in regulating the plan of action.

VIII. Anti-aircraft Defence.

A thorough defence of the Front will entail generally Anti-aircraft Units being sited to form front and second line barrages, and to protect important localities on the rear defensive system.

Units forming the front line barrage are well sited at intervals of about 4,000 yards, and at distances of about 3,000 yards behind our front line.

The number of Units required for the second line barrage is about half the number required for the front line barrage.

The distance between front and second line barrage Units should be about 5,000 yards.

The above distances can be taken as a guide only. The actual siting of Units must be dependent on local circumstances; the value of those whose position is located accurately by the enemy is likely to be comparatively small. Hence, Units should change their positions repeatedly, and good communications facilitating this being carried out with safety and rapidity are important.

During the Battle of the Somme, 15 hostile machines were destroyed and 15 damaged by the anti-aircraft guns on the Fourth Army front.

IX. Preparatory Bombardment.

Irrespective of Counter-battery and "Long-range" Gun work, which have been dealt with, this bombardment aims at the demoralization of the enemy and the methodical destruction of his wire defences, strong points, machine gun emplacements, observing posts, and front line system generally—so far as it constitutes an impediment to the Infantry advance.

Most of the above tasks demand the accurate and observed fire of Heavy Howitzers.

The fire will, therefore, generally be slow and deliberate, based on information derived from all sources, directed by aeroplane observation and checked and corrected by the study of aeroplane photographs.

The character and duration of this bombardment will vary according to the strength of the enemy's defences, his morale, the time available, etc. Generally, it may be taken that the initial bombardment will be a long one (Verdun—a month; Somme—a week).

After the initial defences are broken through, it will be important to exploit the success quickly; the guns, according to a pre-arranged scheme, will be pushed forward as rapidly as possible, and the bombardment will be of shorter duration (three days to six hours).

The importance of ensuring accuracy of fire and of maintaining the bulk of our artillery in action for the day of battle militates against prolonged bombardments of an intensive nature, which are fatal to our equipments.

The destruction of well constructed and deep dugouts is not likely to be attained by Howitzer fire—our hopes in this direction rest principally on Heavy Trench Mortars, which should play an important part in the destruction of the front line defences.

We cannot hope to destroy everything and our efforts should be concentrated on the destruction of those parts which constitute the principal obstacles to the Infantry advance. At the same time, there is no part of the defensive system which we can afford to ignore altogether.

The destruction of the wire defences has hitherto been almost exclusively the province of our Field Guns.

It is hoped that the provision of fuzes acting immediately on impact may enable our Howitzers to play a prominent part in future wire-cutting operations, and that they may be further supported by our Medium Trench Mortar Batteries.

It is frequently necessary for the Infantry to clear back from their advanced positions in order to permit of the bombardment of hostile front trenches without undue risk to themselves.

From in rear of their front line, our Infantry should, by means of machine gun fire and rifle grenades, prohibit any attempt of the enemy to seek cover in advance of their front line, possibly even to enter our own.

Stress is laid on the importance of allowing the Infantry ample time to make all arrangements for temporarily clearing their trenches.

Concealment of the actual time of attack is all-important. To facilitate this the methodical bombardment should be varied from time to time with short periods of intensive fire, simulating the approach of the assault. In these bombardments all guns should join. These occasions form an opportunity for the Field Artillery to test their intended barrage. They likewise afford opportunities for inflicting losses on the enemy, should he be induced, in expectation of an attack, to man his defences, and, finally, of studying the enemy's barrage system, should be he led to open fire.

During the day the Field Artillery should preserve a sharp look-out with the object of inflicting losses on the enemy, should favourable opportunity offer itself, and the Artillery generally should be practised thoroughly in developing fire rapidly in response to aeroplane emergency calls. Otherwise, Field Artillery tasks by day should be confined, as far as possible, to the short bombardments mentioned above, and to any requisite wire-cutting operations or registration.

X. Artillery Action During The Attack.

The importance of the Infantry attacking close under the protective barrage of their own artillery need not here be insisted on.

To achieve this result and at the same time limit the risk incurred by the Infantry from their own artillery fire, experience indicates the importance of close attention to the following points:

9. Accuracy of fire—this will be dealt with later.
10. Simplicity of plan: Constant or small changes in the barrage fire should be avoided.
11. The jumping-off line should be approximately parallel to the front to be attacked. This simplifies both the task of the Infantry and that of the Artillery.
12. The rate of movement of the creeping barrage should be in strict conformance with the rate of advance of the Infantry. It is a matter for the Infantry to determine this rate: it will vary according to the difficulties of ground and obstacles to be overcome.
13. The Infantry must advance punctually to time; any delay created by difficulty in getting out of the trenches must be legislated for in the rate of movement of the barrage.

The creeping barrage forms a protection against machine guns and riflemen concealed in the ground intervening between the Infantry and their objective.

The standing barrage lifts off the objective and forms a screen behind which the Infantry clean up and consolidate the position won. This screen should be adjusted to form a protection against hostile reinforcements or counter-attack.

At the time of the assault the Heavy Howitzer fire will generally be concentrated on strong points or localities of special importance or to cause blocks at trench junctions.

At zero, that is to say, the time at which the Infantry commence their advance, it is inadvisable to make any immediate change in the objectives of the Heavy Howitzers, such as would clearly point to the moment of assault having arrived.

Heavy Howitzer fire should be lifted from one point to another—it is not suitable for forming a creeping barrage in proximity to our Infantry.

In the later stages of the Somme Battle, there was a marked tendency on the part of the Germans to site their machine guns at a considerable distance behind their front line. It is hoped that this may be dealt with adequately by imposing a smoke barrage of 4.5" or 18-pounder shells.

The most effective barrage under ordinary circumstances is one of time shrapnel with long corrector—but in the attack of villages and woods H.E. should be partially or entirely substituted for shrapnel.

As soon as all details connected with the barrages have been settled between the Artillery and Infantry they are issued in the form of orders and should be impressed on all concerned.

After this it is most inadvisable to make changes, which almost invariably result in misunderstandings.

Any what is commonly called "monkeying" with the barrage by subordinates should be absolutely prohibited.

The Infantry are required to conform their movements strictly in accordance with the barrage programme.

The moulding of this programme in accordance with the progress of the Infantry is an ideal which may be attained in the future; if so, it is likely to be so through the medium of aeroplane observation.

It is all a question of reliable information and communication. Hitherto our experience has been that neither of these factors can be relied on to function during the battle in sufficient time and with sufficient certainty.

The results, however, obtained from co-operation between Infantry flares and Aeroplane Observers are encouraging and one of the features of the Somme Battle has been the reliability of Aeroplane Observers' reports in general.

Any local modifications in artillery fire must always be dangerous as affecting the position of troops on the immediate flanks.

A Division is certainly, under normal circumstances, the smallest formation which can be permitted to modify the later stages of the Artillery programme with due regard to the general tactical situation.

The provision of special signals enabling the Infantry to call upon the Artillery to lengthen or shorten their range is under consideration. The use of many signals is to be deprecated as confusing and dangerous. But it should be possible to introduce some simple form of signal for these purposes, aiding to what is, in any case, a much desired result.

There are also possibilities connected with "wireless" which have not yet been fully exploited.

Divisions should generally be allotted an emergency call on certain units of Heavy and Siege Artillery, in order to facilitate local co-operation with the Artillery.

Plans to meet counter-attack both during the attack and after the capture of the position, require to be worked out in detail, and in close co-operation with the R.F.C. and made known to all concerned previous to the day of the attack. These counter-attacks generally afford the Artillery its best opportunity of inflicting severe losses on the enemy.

It is only when acting in close co-operation with the R.F.C., that our Artillery can hope to obtain the best results.

This alone is sufficient to indicate the importance of fine weather as a factor in the attack, in addition to which accuracy of artillery suffers much in bad weather.

If, at the moment of the assault, the defenders' artillery could but grasp the full tactical situation and act on it immediately, no attack under normal circumstances would be likely to succeed. Our own, French, and probably German experience also, has been that the defenders' barrage fire soon after the assault takes place is directed on the assailants' front trenches and that presumably owing to difficulties in obtaining reliable information as to the true state of affairs, is slow to turn on to trenches which are captured.

In the assault, therefore, it is well that all waves of attack should be got clear of the front trenches as soon as feasible. It represents a difficult problem for the defence. If the requisite guns and ammunition are available, it is certainly advisable to develop counter-preparation at an early date and not to await the actual moment of assault.

XI. Accuracy and Rapidity of Fire.

The extent to which our Artillery is now called upon to direct its fire in close proximity to our own Infantry calls special attention to the paramount importance of the factor of accuracy.

This refers alike to Field and Heavy Artillery.

Our attention should, with the object of attaining the maximum of accuracy, be directed specially to the importance of:

14. 1. Correcting for:
    Temperature of charge and air,
    Barometer,
    Wind, and
    Wear of Guns.
15. Grouping when feasible and always calibrating Guns and Howitzers.
16. Close liaison with the Infantry in the line.

17. Obtaining the best observation for the special task in hand. Direct observation is not always desirable. As operations progress, the Artilleryman (Heavy and Field) is required often to occupy some special place of observation and improvise communications. Just as the Infantryman requires time to arrange to clear back from his front line trenches in the case of a close bombardment, so the Artilleryman requires time to arrange observation and communication in the case of the bombardment of some particular locality.
18. Checking the results of shooting by photography. A matter requiring time and close study.

The degree of rapidity with which we can afford to fire our guns is limited practically by two factors:

19. The necessity of combining accuracy with rapidity.
20. The fact that rapid firing is most detrimental to our equipments.

For the barrage fire of 18-pounder guns, three to four rounds per minute per gun may be regarded as the maximum to be maintained for any appreciable time and even then guns should be afforded a rest of about a quarter of an hour in every hour in order to allow them to cool.

XII. General Remarks on Artillery Fire.

The destruction of Material and Field Fortifications is best brought about by steady, methodical and carefully observed fire.

The destruction of Personnel and the prevention of movement is best achieved by sudden and short bursts of fire, at frequent intervals, in preference to slow continuous fire.

A "Smoke Barrage" has practically never failed to draw the fire of the German Artillery. This is a factor to be made use of.

XIII. Co-operation Between Artillery and Infantry.

The various factors affecting co-operation between Artillery and Infantry cannot be discussed here in detail. Generally, it may be said that co-operation demands:

21. An Artillery organization facilitating effective artillery support being rendered.
22. The provision of the necessary means of communication.
23. A thorough knowledge on the part of Artillery Officers of what is taking place and the position of friend and foe on the front.
24. The inter-change of information between Artillery and Infantry and the Infantry in the line being kept informed by their Divisions of any impending Artillery action.
25. The existence of specially detailed Artillery Liaison Officers.

The organization of the Artillery has been discussed.

Artillery units require auxiliary means of Signalling, such as Electric lamps and Shutters, in addition to Telephones.

For the rest, the crux of the whole matter is the vital importance of Senior Officers, Battery Commanders, and Junior Officers of both Field and Heavy Artillery visiting and maintaining the closest relations with the Infantry in the line.

If this is thoroughly carried out, much less will be heard of regrettable errors on the part of our Artillery in shooting and mistakes on the parts of our Infantry in distinguishing between our own and German shells.

During the attack, Brigade Commanders or their Staff Officers should be in immediate touch with Infantry Brigadiers.

Observing Officers should be sent forward, under cover of the Infantry, to enable them to occupy positions from which they are better enabled to direct the fire of their Batteries, in accordance with the tactical situation.

Although this constitutes the paramount duty of those Forward Observing Officers, it should not preclude their doing all in their power to preserve touch with Battalion Headquarters.

Before the day of assault, the Infantry should be made aware of the plan for sending forward F.O.Os in order that they may on their side facilitate the arrangements for communication by means of Runners, etc.

XIV. Equipment and Stores.

During the Battle of the Somme, the want of sufficient guns of long range and the absence of light guns and howitzers made themselves felt, at times severely.

Before the operations commenced the importance of the preservation of guns was realised and measures taken accordingly. Even so, between the 23rd June and the 22nd of November:

89 Guns and 130 Carriages were destroyed by hostile fire.

667 Guns and 338 Carriages were condemned for wear, etc.

The attention paid by Units to their equipment was, on the whole, satisfactory, and the lessons learnt centralise more on the necessity for ample provision of spare parts such as buffer springs and vents, and on the importance of everything possible being done in the Manufacturing Departments at Home to simplify not only the tasks of our men in the line but of those in our Workshops—for whose work during the Battle of the Somme I have nothing but good to say.

XV. Ammunition.

The quality of our Ammunition during the Battle had a tendency to improve. It is hoped that this may continue and that we may gradually reduce the variety in kinds of Ammunition with which the Unit Commander at present has to deal.

The effect of our Thermit shells was disappointing.

It is very difficult to gauge the effect of our Lethal Shells. On the whole it would appear to have been chiefly moral—most felt during the night hours.

The introduction of an instantaneous fuze should add enormously to the effect of our Howitzer fire.

Our Field Gun H.E. requires either as at present—a delay-action fuze combined with ricochet effect—or an instantaneous fuze. Longer burning fuzes are required for our "Long-range" Guns.

Armour piercing shells are useful.

As N.C.T. has come to stay, attention should be concentrated on protecting it from damp—the conditions under which cartridges were supplied during the Battle were in this respect bad, but much is now being done by supplying, strengthening, and improving metal cylinders to remedy past defects.

There was comparatively little shortage of Ammunition during the Battle, and but few difficulties connected with Ammunition supply, until the later stages, when owing to the state of the ground, brought about by shell fire and rain, it became necessary to supply practically all Field Ammunition by pack transport. At this time the absence of roads and railways rendered the supply of Heavy Ammunition a most arduous business.

Men and horses both suffered in consequence of the strain imposed.

One of the most difficult problems to solve is the prompt removal of Ammunition from gun positions when an advance takes place. Our arrangements in this respect were inadequate to prevent a considerable amount of ammunition becoming derelict.

Every formation, Army—Corps—Heavy and Divisional Artilleries—should detail an Officer to supervise the strict performance of orders issued on the subject.

The total number of rounds fired from June 24th to November 21st, 1916, both dates inclusive, were:

18-pounder	10,844,411
4.5" How:	2,222,857
4.7" Gun	163,239

60-pounder	800,633
6" How:	831,862
6" Gun	59,293
8" How:	292,660
9.2" How:	260,807
9.2" Gun	2,630
12" How:	17,425
12" Gun	1,153
15" How:	2,803
13-	61,022
GRAND TOTAL	15,560,795
Avg. per day	102,439
Wt. in Tons, approx.	255,000

The Total Expenditure on June 30th and July 1st together amounted to 600,000 rounds, and this figure was repeated almost exactly on September 14th and 15th.

XVI. Personnel.

Spare personnel—Officers and men—to take the place of those suffering from overstrain of work, in addition to those killed and wounded, are requisite. Special Rest Camps should be established for Officers and Men in need of a short period of rest.

The enormous amount of extra labour connected with Ammunition supply and preparation of new positions also demands extra labour—in fact, it must be recognised that the fixed establishment of Artillery personnel is inadequate for a great and prolonged battle.

The total casualties in the Artillery of the Fourth Army were:

	Officers		**Men**	
	Killed/Wounded	Missing	Killed/Wounded	Missing
R.F.A.	147	737	1363	6066
R.G.A.	37	142	300	1593
T.M.B.	55	178	436	1329
	239	1057	2099	8988

[T.M.B. means Trench Mortar Battery.]

GRAND TOTAL 12,383

19: SS139/4, Artillery in Offensive Operations, March 1917

Source: IWM SS/CDS Pamphlet collection

Artillery Notes.

(Issued by the General Staff at General Headquarters.)

No. 4. Artillery in Offensive Operations.

This cancels Artillery Note No. 4 issued April, 1916.

[To be studied in conjunction with "Instructions for the Training of Divisions for Offensive Action," (O.B./1635, December, 1916) and "Artillery Notes. No. 3.‹Counter-Battery Work" (S.S. 139/3) issued by the General Staff.]

February, 1917.

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Organisation and Command.</FONT< b>

7. Artillery has so developed both in power and quantity during the past two years that it has become a much stronger weapon of offence than heretofore. To obtain the full value from this arm, which plays so great a part in battle, it is essential that its action should be so efficiently controlled as to ensure that its maximum force is utilised. Every detail regarding the employment of artillery must be thought out beforehand. The efficient execution of its allotted tasks will largely depend on the early issue of clear orders and on the methodical supervision of its subsequent work.

8. A Commander directs and supervises the action of his artillery through the medium of his Artillery Commander, who must be equipped with the authority, information and technical knowledge essential to his position.

The Artillery Commander attached to the Staff of an Army or a Corps may, within the discretion of his Chief, command the whole of the artillery of the formation; in order that the Commander's plan may, as far as the artillery is concerned, be translated into orders and be carried out in the most effective manner and with the least delay. The rapid transmission of orders to batteries is a matter of vital importance.

9. The Army deals with the distribution and employment of the artillery allotted to it, and with the details of artillery co-operation with Armies on either flank. It provides for co-operation between the various Corps and decides, within the limitations imposed by the Commander-in-Chief, the nature and duration of the preliminary bombardment.

The Army is also concerned with the general direction of the preparatory arrangements; lays down the general principles to be followed as regards the employment of anti-aircraft guns, counter-battery work, night firing, enfilade fire and concentrations of fire; and indicates the most effective methods to employ in the attack.

10. A Corps Commander disposes of every nature of artillery essential to the preparation and execution of an offensive operation. There can, therefore, be but one Commander for all the artillery of the Corps, both Field and Heavy, if the energy of the whole is to be sys-tematically and uniformly directed. At the same time, the Army Commander may decide to retain certain units of Heavy Artillery under Army control, and, in many cases, will at least lay down the special objectives to be engaged by the long range big guns (6-inch, 9.2-inch and 12-inch).

11. A table showing the details of organisation of Artillery com-mands is given in Appendix I.

This new organisation recognises the great importance of recon-naissance work on the part of the artillery, and each Artillery Staff is provided with an officer charged with the execution of such work. The study and collation of information derived from air photo-graphs and maps, as far as it affects the artillery, form an important feature of the officer's duties.

The organisation of the Staff of the Corps Heavy Artillery Com-mander is designed to meet the double task that falls on his shoulders. Broadly speaking, destruction of defences and of communications, combined with barrage work, comprise the one branch of Heavy Artillery work; Counter-battery work the other. It is, however, essential that no hard and fast line shall be drawn between these two main sub-divisions of the Heavy Artillery Commander's duties. Organisation must be so supple as to ensure that at all times it shall be a simple matter to devote any

proportion of the Heavy Artillery to either task, according to the needs of the tactical situation, without delay and without confusion. Arrangements must be made to ensure that Heavy Artillery Groups engaged on trench bombardment are in a position to co-operate closely with the Divisions interested in the hostile trenches in question.

12. Army Field Artillery Brigades have been formed to provide a means whereby a mass of field artillery may be concentrated for any special purpose. Such brigades can be allotted to Armies, Corps and Divisions as circumstances may require.

    Despite this new organisation, a Division in the early stages of an offensive operation will often require for its support more field artillery than is afforded by its own Divisional Artillery; even though reinforced by such Army F.A. Brigades as may be allotted to it. In this event, two or even three Divisional Artilleries may be found supporting the operations of a single Division. In such cases all this field artillery will normally be grouped under the C.R.A. of the attacking Division.

13. The composition of heavy artillery groups may, as explained in "Artillery Notes, No. 3" (Counter-Battery Work), consist of both gun and howitzer batteries, or of either nature separately; so long as the action of all the batteries devoted to any one area is controlled by one authority. One point, however, must always be borne in mind, and that is that the composition of Heavy Artillery Groups must envisage the demands of an early advance. Mixed groups of medium and heavy weapons present the obvious disadvantage that in the event of a rapid advance, either the medium batteries (which will be the first to advance) must break loose from their groups, or fresh groups must be automatically formed to control the advancing batteries.

14. The relations between the Artillery and the Royal Flying Corps must be of the closest if these two arms are to work together effectively to the common good.

    This particularly applies to the case of counter-battery work, as is impressed in the "Artillery Notes" (No. 3) dealing with that subject. G.Os.C., R.A., of Armies (or Corps) deal direct with the Commanders of Corps and Balloon Wings (or Squadron and Balloon Companies) in all matters relating to their combined work, and should do all in their power to impress upon their subordinates the value resulting from mutual confidence based upon mutual under-standing. The Corps and Balloon Wing Commanders are, however, the executive commanders of the Corps Squadrons and Balloon Companies respectively and as such act as the technical advisers of G.Os.C. R.A. of Corps, with whom they should be in the closest touch.

II. Artillery in the General Plan of Attack.</FONT< b>

15. The Role of the Artillery.

The rupture of the enemy's front, generally strongly defended and organised in

depth, is the first phase of an offensive battle.

This entails the destruction of the obstacles to the infantry's advance and of the means of defence that support those obstacles; the moral and physical reduction of the defenders; and lastly a rapid and combined advance of all arms acting in close co-operation.

Thereafter successive phases may comprise a modified form of the first; namely the attack of improvised lines of defence with but little time for deliberate preparation, leading to a final phase of open warfare.

Experience has proved that effective artillery preparation is in-dispensable to success, the extent and nature of the preparation depending on the scope of the intended operation. In each sub-sequent phase the artillery must aim at maintaining the closest touch with, and affording the greatest support to the infantry. The measure of ultimate advantage will largely depend on the momentum of the first blow, and the rapid exploitation of early successes before the enemy has time to recover from the shock.

16. Selection of the Front of Attack.

Granted the vital importance of effective artillery action in the offensive, it follows that the general plan of attack must be such as to admit of a full development of artillery fire and of complete co-operation between the artillery and the infantry.

For this it is not enough that the requirements in guns and ammunition should have been carefully estimated and adequately provided. The first and most essential element of success is that the front selected for attack should be of a nature to admit of this full development and co-operation. Conditions are most favourable when the ground allows of artillery commanders—

- **i. seeing clearly the enemy's defences, and also following the movements of the attacking infantry;**
- **ii. controlling the fire of their guns rapidly and effectively. For, however carefully thought out the arrangements for the control of both artillery fire and infantry movement may be, they are always liable to be thrown out of gear by some unexpected development.**

It is, then, the first duty of the artillery commander to place before the general officer commanding the force full particulars as to the manner in which the ground affects the efficiency of the artillery preparation and support, so that the latter may give due weight to such considerations in selecting the front of attack. "An objective which may appear at first sight easy of access to the infantry, may prove in the end costly to attack, if it does not lend itself to the judicious application of artillery fire; and *vice versa,* localities which present difficulties to the infantry alone may, if it is possible to bring the converging fire of artillery to bear on them, be carried

with comparatively little loss."

17. Estimate of Guns and Ammunition Required.

The general plan of attack having been settled, it is the next duty of the artillery commander to prepare an estimate of the amount of artillery and of ammunition required for the operation.

The first point to remember is that the ammunition required depends upon the work to be done, more than on the number of guns available. The latter is, however, the governing factor as regards the time which will be required for the preparation, and has therefore an important bearing on the general plan of attack. If surprise forms any part of this plan, it is essential that sufficient fire units should be available to allow the different portions of the enemy's defences to be bombarded simultaneously. The number of hostile batteries to be dealt with is another consideration directly affecting the amount of artillery that will be necessary.

The nature of guns required depends, like the ammunition, on the character of the work to be performed. Every type of gun or howitzer is particularly adapted for certain tasks, and the pro-portion of each type demanded should be based on such considerations.

An estimate of the guns and ammunition needed can, there-fore, only be made after thorough reconnaissance of the enemy's system of defence; including his trenches, machine-gun emplacements, observing stations, communication trenches, rear lines, strong points, wire, &c. This reconnaissance must include not only the examination of the ground from all possible points of view, but also the reports of air observers, and a very careful study of maps, air photographs, and of all information available in the intelligence section. This section should indicate the roads used by the enemy in bringing up reinforcements and supplies of ammunition and food, the places where they can best be blocked by artillery fire, and the forming-up places likely to be used for counter-attack. The number and nature of the guns which may be brought into play by the enemy is also an important factor, as it governs the requirements for counter-battery work.*

It is important that the Artillery Commander should make this reconnaissance in company with the General Staff of the formation, and that the fullest information, regarding not only the enemy's defences but also his habits, should be obtained from both the artillery and the infantry holding the front.
[* Counter-battery Work has been dealt with in a separate note (No. 3 of this series).]

III. The Artillery Plan. **</FONT< b>

18. Scope of the Artillery Plan. In all offensive operations it is the duty of the Artillery

Commander of the force engaged to prepare an artillery plan, based on and supplementary to the general plan of attack.

To enable him to do this he should be informed as early as possible of the minimum resources of guns and ammunition that will be available.

The plan should consist of a clear and complete statement of the objects to be attained by the artillery and the methods to be employed. It will lay down the allotment, grouping and organisation of the artillery (including medium and heavy trench mortars) for the attack; the tasks and zones of the various commands; and the arrangements for observation, communication and the co-operation of aeroplanes and balloons. It will deal with the establishment of artillery command posts, the expenditure and supply of ammunition, arrangements for liaison with the infantry, the forward movement of batteries, and any other points regarding the action of the artillery which it is necessary to include. The measures to ensure co-operation between subordinate formations and the possibility of bringing a heavy concentration of fire on to particular areas, if required, must be thought out and clearly defined. The preparation of this plan will thus involve a comprehensive consideration of all the tasks which the artillery will or may be called upon to perform during the preparation and execution of the attack.

The plan must embrace each phase of the battle, and careful arrangements must be made to ensure that one phase shall follow another without any unintended break in the action of the artillery.

The lower the formation concerned, the more detailed will be both its artillery plan and the study and reconnaissance upon which that plan is constructed. As soon as the broad outline of the artillery plan has been worked out and approved, it is advantageous to issue it to subordinate commanders concerned, or at least to make it known to them at a conference; in order that they may have the earliest opportunity of studying and solving their individual problems. Even if circumstances ultimately entail modifications in the sub-allotment of artillery and in the apportionment of tasks, the inconvenience arising from minor changes in subordinate plans is far outweighed by the advantage gained by the increased time thus rendered avail-able for consideration of the general tasks demanded and for recon-naissance. To complete the manifold arrangements essential to the successful execution of an artillery plan is necessarily a lengthy process. The early publication of the plan, even if not in all its details, will greatly assist the work of subordinate artillery commanders.
[See Appendix A., para. 2. of "Instructions for the Training of Divisions for Offensive Action."]**

19. Allotment of Artillery.

The number and variety of the tasks which the artillery is called upon to perform necessitate very careful arrangement, if the different natures are to be employed to

the fullest advantage. These tasks depend upon, and must therefore vary with the nature of the enemy's defences and the strength of his artillery. The following principles, however, will generally apply.

Roles of Various Natures of Artillery.

Field guns (18-pdr.) are primarily employed in barrage fire, repelling attacks in the open, raking communications and wire cutting. They may also be employed for neutralizing fire against batteries within their reach, and to assist in the destruction of such enemy defences as are vulnerable to the H.E. shell of field guns, e.g., breastworks and barriers. They will also be required for the purpose of preventing the enemy from repairing damage to his defences, where this work is beyond the power of the infantry.

Medium guns (60-pdrs.) are employed in counter-battery work, especially for neutralization; for raking communications, and form-ing barrages beyond the range of field guns.

Heavy guns (6-inch, 9.2-inch, and 12-inch) are used against villages, camps, dumps, railway stations, &c., beyond the range of other artillery. Also against observing stations, such as chimneys and church towers, and occasionally for long range counter-battery work.

6-inch guns are also used against balloons and for enfilading distant trenches.

Field howitzers (4.5-inch) are employed for the bombardment of the weaker defences; enfilading communication trenches and against troops that are badly entrenched; for destructive counter-battery work against ill-protected batteries and for neutralization with gas shells; for barrage work, especially by night; also (when No. 106 fuze is provided) for cutting wire which is beyond the wire-cutting range of field guns (3,200-3,400 yards), wire at short distances from our own trenches, in hollows, on iron standards and of the "knife-rest" type.

Medium howitzers (6-inch) are used for destruction of defences and against entrenched troops. They are very effective for neutralizing fire against hostile batteries, though not really powerful enough to destroy well constructed emplacements. They are of great value for destructive work in an advance, when the enemy's guns are forced back into positions more or less hastily constructed, and can also be used with No. 106 fuze for barrage fire and for wire-cutting.

Heavy howitzers (8-inch and 9.2-inch); the principal roles of these weapons are counter-battery work against batteries provided with good cover and the destruction of strong defences. They also may be employed for barrage work with No. 106 fuze.

Super heavy howitzers (12-inch and 15-inch) are required for the destruction of

specially strong defences, bridges, &c. The 12-inch howitzer is also used with great effect for counter-battery work.

Light trench mortars* may be used to harass the enemy in the final stage of the bombardment, for barrage work and for the close support of the infantry. They are not usually employed during the course of the preliminary bombardment. Medium trench mortars* are employed to assist other artillery in wire-cutting and in the preliminary bombardment. Owing to their liability to be destroyed by hostile artillery fire it may often be advisable to defer opening fire with these mortars till the last day of bombardment.

Heavy trench mortars* are of value for the destruction of dug-outs and strong points within the limits of their range.

In allotting tasks to guns and howitzers for the preparation of an attack on a large scale, simplicity must be the keynote of the scheme. Heavy howitzers' tasks should preferably be arranged in "lanes" in the same way as are those of field guns. Enfilade fire against the enemy's main system of defence, in the case of all heavy artillery, should as a general rule only be employed for special reasons (e.g. in the case of a limited offensive or of a marked salient). Guns and howitzers placed for enfilade fire can usually only play a very limited part in the actual attack and, the greater the success, the earlier will they have to change to an entirely new arc of fire. Moreover signal communications are greatly complicated under conditions of enfilade.**

[* The handling of Trench Mortars as a whole is dealt with in Artillery Notes No. 6.—Trench Mortars.]

[Enfilade fire from field artillery will often offer great advantages (see para. 12 Section VI.).]**

20. Air Observation

A great deal of artillery work, especially counter-battery work, must depend upon the co-operation of the Royal Flying Corps. It is the duty of the Artillery Commander, in consultation with the Royal Flying Corps Commander concerned, to consider the most suitable allotment of the aeroplanes available, and to include in his artillery plan the arrangements decided upon. A factor which must always be borne in mind is the jambing of wireless. This limits the number of machines which can work on any particular front at the same time. One machine to every thousand yards may be taken as a maximum.

Pilots and observers allotted to artillery work should, in principle, work with the same units throughout both the preparation and the battle itself, and should be changed as seldom as possible. Close personal touch between pilots and observers and the battery commanders for whom they work is of the first importance.

Balloon companies are allotted to Corps for artillery work and must work in close

touch with the Corps Squadron. The selection of suitable targets for the aeroplanes and balloons is the duty of the artillery commander, who should make a point of seeing his Corps Squadron and Balloon Company Commander together every evening to decide the allotment for the ensuing day. An intimate knowledge of the country is the chief essential of successful balloon observation. Balloons should, therefore, be changed from one area to another as seldom as possible.

The principles governing the work of aeroplanes and balloons for the artillery are explained fully in "Co-operation of Aircraft with Artillery" issued by the General Staff, December, 1916 (S.S. 131).

IV. The Preliminary Arrangements</FONT< b>

21. Reconnaissance

Thorough reconnaissance of the enemy's defences and dispositions, and also of the ground available, is the first step in the work of preparation. With this object it is of the greatest importance that the various artillery commanders should get into touch as soon as possible with the commanders of the infantry whose attacks they are to support. Equally must they establish an early understanding with the R.E., Signals and R.F.C officers on whose assistance they rely.

Maps or diagrams require to be prepared showing the artillery tasks in detail, wire to be cut, defences to be demolished, routes to be employed by artillery in movement, signal communications, allotment of O.Ps. charts of visibility from O.Ps., and arcs of fire or other means of showing the quantity and nature of fire that can be brought to bear on any given point.

Many of the necessary reconnaissances must be made in conjunc-tion with the infantry or other officers directly concerned with each particular problem; in that time may be saved by all arms and branches working in close co-operation from the first. Infantry officers should examine the ground from artillery observing stations, artillery officers from the trenches and from balloons and aeroplanes, while combined reconnaissances from the ground or from the air must be completed by joint study of aeroplane photographs and maps.

By these means not only should no point for consideration be over-looked, but each arm will learn to appreciate the capabilities and limitations of the others.

22. Distribution of Work.

A thorough understanding of the work to be done, and of the time at which it is to be done, is essential to the success of the artillery preparation and subsequent action. The work must first be divided amongst the subordinate artillery commands, e.g., in the case of a corps between the different divisional artilleries and

the heavy artillery. Subordinate commanders then allot tasks and zones to their brigades and groups and the commanders of these to their batteries.

23. Positions.

Positions will have to be found for the large number of extra guns, howitzers and trench mortars which will be required for an offensive operation of any size; as well as probably for several of those already in action whose original positions were selected with a view to defence.

The artillery must aim at extending its destructive action over as deep a zone as possible, and at being able to engage the enemy's most distant batteries. These considerations and the importance of reducing movements of guns to a minimum during the earlier stages of a battle demand that a large proportion of the attacking artillery shall be placed well forward.

What this proportion should actually be will depend chiefly on the range to the various objectives, the ground, the facilities for ammunition supply and the characteristics of the material. It is a mistake to mass a great number of batteries within too confined an area (particularly a valley), where they may all be neutralised at the same time by a comparatively few hostile guns or by a gas attack.

It may sometimes be necessary for corps and divisions to place their batteries outside their own area. Whenever this is the case the necessary arrangements should be made by the next higher formation; but it is to be remembered that the placing of a battery outside the area of its own formation nearly always entails certain difficulties as regards signal communications, ammunition supply and subsequent advance. This procedure, therefore, is not to be recommended unless distinct tactical advantage is thereby gained.

24. Protection of Positions.

The procedure of withdrawing the detachments from a battery which is being shelled is incompatible with the preparation and support of an infantry attack, when the guns must be fought regardless of the enemy's fire. In principle, therefore, every field and medium battery should, as far as possible, be provided with cover strong enough to resist bombardment by the enemy's heavy field howitzers (5.9-inch).

Considerations of labour and material may, however, prove to be limiting factors, and in this case a careful system of concealment (camouflage) must be adopted for such batteries as are not otherwise protected. Even so, it is essential that shell-proof cover should be provided for the detachments close to the guns. The battery command post must always be strongly protected. Large reinforcements of artillery will usually arrive within a week or two of the opening of the preliminary bombardment, and their actual positions, telephone communications, approaches,

and ammunition dumps must be well on the way towards readiness, as these matters are essential to con-trol, direction, and delivery of fire. In order that on arrival these batteries may waste no time in preparing their positions, large dumps of R.E. material should be made at convenient points at an early date. Tables should be prepared, showing the average amount of material required to dig in a battery of each calibre, so that indenting may be simplified and a battery be able to draw its materials and to begin work without delay. When batteries move forward there will be a great demand for protective material, and this fact must be borne in mind when allotting resources.

Apart from the question of the strength of the cover provided, the concealment of emplacements should always be studied during their actual construction. As soon as work starts, either camouflaged screens or rabbit-netting threaded with grass, &c., can be erected on short stakes over the area to be excavated while the personnel work underneath. In this connection it must be remembered that, during the preparation for an offensive on a large scale, the difficulty of concealing guns and tracks leading to them will be greatly lessened by the fact that the ground, within about three miles of the trenches, will be broken up in every direction by numerous other constructional works.

Guns concealed in the neighbourhood of ruined villages, rubble-heaps, brick-stacks, and so on, are particularly difficult of location from the air. Field Artillery ammunition should always be strongly protected against hostile artillery fire, while the cartridges of heavier natures should be similarly treated, even if it is not possible to do the same for the shells.

25. Observing Stations.

The provision of a sufficient number of strongly constructed observing stations and of covered approaches to them is a matter of vital importance. To risk the interruption at critical moments of the whole system of directing artillery fire for want of energy in this matter is inexcusable. Telephonists' dug-outs and exchanges must be made practically impervious to artillery fire. All work of this nature must be treated as a matter for continuous attention, and must never be left to the eve of an offensive. Corps must arrange for considerable assistance by Royal Engineers in this work which cannot be effectively executed by gunners alone. Every part of the hostile lines should be visible from at least one O.P.

The allotment of O.P.'s is a matter calling for the direct intervention of Corps Artillery Commanders. All Artillery headquarters, from Corps downwards, should possess a chart showing what can be seen of the enemy's defences and territory from each O.P. under their control, and also a photograph of the view from each. Armed with this information it is the duty of the Corps Artillery Commander to allot observing stations to the Artillery of the Corps, so that the best value is obtained from them. O.P.'s will usually be allotted to certain batteries, at least as regards maintenance and control; but it will often occur with large concentrations

of artillery that any one O.P. may have to serve two or even more batteries.

The establishment of special Artillery Observing Stations for watch-ing the progress of the infantry and reporting it to Corps Artillery Headquarters has proved to be of great value. The probable future positions of similar stations on the far side of the hostile trenches, should be studied and be made known to the infantry before the assault, so that they may be available for the transmission of information in general.

26. Artillery Command Posts.

The selection of Artillery Command Posts (including Brigade and Group Headquarters) is another important matter which must be done by General and R.A. Staffs of Corps in consultation. These command posts should not be changed until the time to advance arrives, when they should be moved to equally permanent positions. They must be so sited that they are likely to be out of constant shell fire, as once communication between Artillery Commanders and their batteries becomes impossible or even difficult, organised operations cease.

27. Communications.

Previous to an offensive operation it will be necessary to provide the requisite communications for a much larger force of artillery than will normally be engaged in holding the line, and this requires very careful organisation. The actual communications to be established in each case must depend upon the organisation of the artillery. They will include, in addition to the ordinary framework in the way of command posts and observing stations, the communications required by the higher Artillery Commanders. These latter will be laid by the signal service, but it is essential that such circuits should be kept quite distinct from the general system.

In order to save labour, and at the same time to obtain real efficiency in telephonic communications, the whole of the artillery communications in the Corps should be worked out as one plan by the Corps Signals, who must take executive control of all artillery lines. Corps signal schemes must be co-ordinated by Army Signals. An organised system of trunk lines and exchanges in the forward area, supervised by experts, is best calculated to attain the end in view at minimum expenditure of resources. Large infantry working parties for digging in wires will be required both in the preparatory stages and after an advance. This must be taken into consideration when labour requirements are being calculated. It is impossible to take too many precautions to avoid the interruption of communication.

In addition to protecting the telephone wires, as far as this is possible, preparations must be made for the rapid opening of alternative means of communication. Visual signalling is the most important of these, and stations should be selected and established. Possible points in the enemy's lines should also be selected beforehand, so that, after the attack has succeeded, intermediate observers may know where to look for signals. The establishment of central stations from which messages can be

sent on by telephone will prove of great assistance. Short range wireless sets have been successfully used (up to 7,000 yards) where visual signalling is impossible; but in such cases reliance will often have to be placed on orderlies, either on foot or on bicycle. Here, again, arrangements must be made in advance so that everyone may know what to do when the time comes.

28. Control and Direction of Fire.

Accuracy of fire is a matter of the utmost importance. It demands studious attention to calibration of guns, calculations for atmospheric and other errors, and to the selection and thorough registration of a few well-chosen Datum Points which must be daily used for checking ranges.

Artillery boards, carefully prepared and kept up to date, are an essential to this system which, particularly in the case of heavy howitzers, is more satisfactory, more economical in ammunition and less likely to disclose the amount of artillery present than was the old system of indiscriminate registration of innumerable points. The latter has proved to be neither necessary nor desirable.

In order, however, to ensure that newly arrived batteries shall be able to register their Datum Points with absolute thoroughness, and that all batteries shall be able to check their ranges two or three times a day on these points (a matter of the utmost importance during the bombardment, and even more so on the day of attack), it is essential that Corps Artillery Commanders shall make detailed arrangements for this work to be carried out, so that confusion of observation shall be avoided.

As already explained, the simpler the artillery fire plan is, the greater the hope of its successful execution. If the ground to be bombarded be divided up into lanes and clearly defined areas, both checking ranges on Datum Points and observation during bombardment will be immensely facilitated. Lanes or areas* must be distributed on a time table issued daily by the Corps, so that every hour is fully occupied. Unless every Battery Commander follows a clear system based on these lines, great confusion will inevitably result and the efficacy of the artillery fire will be correspondingly diminished.
[* Areas should be about 500 yards square, each containing a definite target, such as a line of trench, running approximately across the centre.]

29. Trench Bridges.

The preparation and transport by artillery of portable trench bridges has not been found to be universally necessary. Trenches are crossed more easily and more quickly by the simple process of filling them in. Good strong bridges are, however, required in large numbers for constructing ammunition routes across captured trenches in the event of wet weather, as under such conditions the filled-in places over which guns may have crossed will soon become soft and impassable.

30. Ammunition Supply.

During the preparatory period the preliminary arrangements in connection with the supply of ammunition are amongst the first matters to be taken in hand, for the Commander's power of manoeuvre is largely dependent on the supply of ammunition. To ensure the smooth working of this supply, careful plans must be made from the commencement.

The construction of railways, light railways and roads for the conveyance of ammunition must be started a long time before operations commence. Roads without railways can ill stand the strain of ammunition traffic. Wherever possible, special roads should be reserved for the use of ammunition lorries and wagons, so that their own movements and the movements of troops may not be blocked. Material for the extension of the light railways should be dumped near their termini, in order that they may be carried for-ward as soon as the advance takes place. It has often been found that the state of the ground after a bombardment makes it impossible to supply ammunition, except by pack transport, to those batteries that have advanced. Arrangements must be made before-hand to deal with these conditions if there is any possibility that they will arise.

In order to meet any possible breakdown in the railway or other unforeseen emergency, an Army reserve of ammunition should be made in a central position before the commencement of operations. In excess of their echelons, which must be full, Corps should dump sufficient ammunition for the preliminary bombardment, and for expenditure on the day of attack and the day after the attack. At least 20 per cent. of the ammunition so dumped should be held in Corps reserve. In addition, each battery should dump at its position sufficient ammunition for its own requirements plus a small reserve, and not according to a fixed scale. All the ammunition should be close to the guns in order to save labour during the strenuous periods of the preliminary bombardment and the day of attack.

31. Anti-aircraft Guns.

Anti-aircraft Artillery must be disposed during the preparatory period so as to prevent hostile aircraft from reconnoitring and from bombing ammunition dumps, railways, &c. As a general guide, units forming the front line barrage are best sited at about 4,000 yards apart, and at an average distance of 3,000 yards behind the front line trenches. Units required for the second line barrage will generally amount to about half the number of those required for the front line, and should be placed at a distance of about 5,000 yards from them. Anti-aircraft gun positions, once definitely located by the enemy, are unlikely to remain tenable for long. Units should, therefore, change their positions frequently, and this entails the selection and preparation of an adequate number of sites, each of which must be linked up to the Army anti-aircraft telephone system.

V. The Preliminary Bombardment.*</FONT< b>

32. Object of the Preliminary Bombardment.

The task of the Artillery in an offensive battle is to prepare the way for the infantry and to support and protect the infantry throughout its progress. The preparation of the way is achieved by the preliminary bombardment which aims at—

. the overpowering of the hostile artillery;
a. the physical and moral reduction of the enemy's infantry;
b. the destruction of material obstacles to the advance of the attacking infantry and of other defences.

Action against the hostile artillery, a matter of the greatest importance in all operations, is dealt with in detail in G.H.Q. Artillery Notes No. 3—Counter-Battery Work, and will only be referred to in this paper in general terms.
[* See Section III, para. 3 of "Instructions for the Training of Divisions for Offensive Action."]

33. Fire to Effect Physical and Moral Damage.

The enemy will suffer a certain degree of physical and moral loss both from action against his artillery and from the destructive fire directed against his defences. But his power of resistance must be reduced by further special measures. Fire must be directed with the object of denying to the enemy the arrival of reliefs, reinforcements, ammunition and supplies of all kinds. Communications, places of assembly, bivouacs, billets, dumps, railway stations, head-quarters, &c., must all be attacked by artillery on a considered and clearly ordered scheme. The share of Field Artillery in this work consists by day chiefly in searching communication trenches (especially trench junctions) between the points bombarded by heavier natures and other approaches that are hidden from view, while by night it will fire on communication trenches, tracks, roads, cooking places, and so on in the forward zone. The heavy artillery should fire by day and by night on roads, railways, billets and other targets beyond the reach of field artillery. The damage to roads effected by the general bombardment has proved to be a serious obstacle to the subsequent advance. This point must be borne in mind when ordering the fire of heavy howitzers on or in the neighbourhood of main roads. The use of instantaneous fuzes in these circumstances may minimise the damage done.

In selecting batteries for these tasks due regard should be paid to the obvious advantage of enfilade fire against communications of all kinds. Gas shell, if used in sufficient quantity, may give good results against such objectives as ravines and woods; especially at night when fear of them will compel the enemy to wear gas helmets.

The guiding principle of all artillery fire against communications, &c., is to employ

short sharp bursts of fire at irregular intervals of time. By day these tasks will not call for the special employment of a large number of pieces. On the contrary batteries of suitable calibre and selected with regard to their position should be detailed to carry out this work in addition to other duties. By night, however, fire of this nature must be much more vigorously conducted in order that the enemy's efforts to relieve or supply his forward troops may only be possible at the cost of heavy casualties and that the moral of his garrisons may derive no benefit from a comparative lull in the artillery fire; indeed a searching shrapnel fire on approaches must be almost continuous. To achieve this without imposing on the artillery too great a burden it is necessary to reserve a certain number of field batteries (gun and howitzer) and of sections of heavy artillery especially for night-firing tasks, or else to organise a system of reliefs of personnel within batteries. Otherwise the artillery will either be tired out before the assault or the night firing will not be conducted with the vigour and care that are so essential. Infantry can co-operate with the artillery against near objectives by means of direct and indirect machine gun fire.

A sound fire scheme of this nature can only be prepared after a detailed study of maps and air photographs, assisted by information gleaned from prisoners. During the bombardment itself, if of any considerable duration, the plan should be constantly reconsidered and modifications introduced, so as to keep the enemy in a state of uncertainty as to our intentions and therefore exposed to loss. This phase of the artillery action is highly important and must never be allowed to become a mere matter of routine. Every round expended on a definite plan, right back to extreme range, is well spent.

34. Destruction of Obstacles—Wire-cutting.

The principal obstacle that has usually to be destroyed is the enemy's wire. Wire-cutting has been in the past chiefly the "task of the 18-pdrs. and medium trench mortars, and is carried out in each divisional zone by the Field Artillery allotted to that zone, any assistance required from neighbouring Field Artillery units being arranged by the G.O.C. R.A. Corps." The provision of instantaneous and non-delay fuzes for howitzers introduces an entirely new factor into the wire-cutting problem, which it may become possible to solve far more easily and in much less time than has hitherto been the case.

"Wire-cutting demands the closest co-operation between the artillery and infantry. Commanders of assaulting battalions should visit the O.P.'s of the batteries cutting the wire on their front to watch the progress of the work, and should inform the battery commanders when they consider that the wire has been properly cut. In addition, patrols should be sent out nightly during wire-cutting to examine and report on the progress made during the day."

"Once gaps have been made, it is the duty of divisional commanders to employ all means at their disposal to keep these gaps open during the hours of darkness throughout the period of the preparatory bombardment. These means include the

use of rifle and machine-gun fire, rifle grenades, &c. Much artillery ammunition can thus be saved, and so can be used for strengthening the fire on communication trenches and other approaches."* The amount of artillery fire that is generally available in any offensive battle is now so great that wire, as a factor of defence, tends to lose much of its old importance.

[* See Section III., para. 3, of "" Instructions for the Training of Divisions for Offensive Action."]

35. Destruction of Defences and their Accessories.

The objectives that are to be destroyed during the preliminary bombardment are stated in the Corps' artillery plan, after the ground, maps, air photographs and all other sources of information have been thoroughly studied. To attempt complete destruction of the enemy's trenches is impracticable, except in the case of enfilade fire, and it is unnecessary. The artillery's task being to open the way for the infantry, its fire must be directed towards breaking down, firstly, the enemy's material powers of resistance and, secondly, his means of directing his defence, incidentally thus increasing his demoralisation by causing casualties and inducing confusion. The enemy's material powers of resistance include such targets as machine-gun emplacements, strong points, important trench junctions, selected dug-outs, and other shelters. His signal communications, command posts, observing stations, water-pipe systems, &c., must be shelled with the object of disorganising his defence. As a general principle it is best, particularly in the case of a long bombardment, to destroy first those objectives which are most dangerous, or will give the enemy the most trouble to repair.

The extent of the ground to be bombarded will naturally depend upon the objective assigned to the attack. In all cases the enemy's defences for several hundred yards to either flank, the distance depending upon the lie of the ground and the trace of the works, must be dealt with as severely as the front of attack itself; while all salients within 1,200 yards of the front attacked, from which flanking fire could be brought to bear, must receive drastic treatment. The *enemy's system of communication* (telephone and telegraph) should be broken down at the outset; fire being directed with this object in accordance with the information gleaned from prisoners and air photographs. The object will naturally be best obtained by shelling battle headquarters and telephone exchanges where many wires meet.

Important *trench junctions* must be destroyed so that reliefs and ration parties, &c. may be compelled to expose themselves to shrapnel fire.

Deep *dug-outs* present an almost invulnerable target, even to the heaviest artillery; the best result that can be expected is the blowing in of some of the entrances. But such dug-outs, though they afford good protection, should not prove an ultimate salvation to the enemy's infantry, who will be unable to emerge from them in time to meet the assault, if the barrage and the infantry's advance are properly co-ordinated and exactly executed.

Machine guns **still remain a formidable asset to the defence. A certain number are housed in concrete emplacements, and these must be destroyed before the assault takes place. The best method of dealing with machine guns which are maintained in deep dug-outs and brought up to the parapet to repel an assault is considered in the paragraphs dealing with the field artillery barrage. Another method frequently employed by the enemy has been to place machine guns in shell holes and other ill-defined positions outside the actual trenches. These, though more commonly met with in the later stages of the battle, may be successfully countered by searching all the ground in front of and behind the immediate objective with shrapnel every day, a procedure calculated to make any shallow position untenable. The "Creeping Barrage" should finally account for any machine gunners that survive.**

The destruction of *observing stations* is dealt with in "Counter-Battery Notes"; they must not be overlooked.

The destruction of *trenches and strong points* is primarily the task of trench mortars and howitzers of all descriptions, other than the field howitzer which, in future, will have nothing but instantaneous fuzes and so be chiefly a man-killing weapon. "Guns can, however, be employed with advantage against breastworks, trenches taken in enfilade, barricades, houses and other vertical targets."

"The extent to which the enemy's trenches and works should be destroyed has become a matter for serious consideration."* If they are more or less completely demolished, little or no cover will be left for our infantry. This, though of no moment in the preliminary bombardment of the enemy's front line system of defence before the launching of an attack on a large scale, has been found to prove a grave disadvantage when the trenches gained have to be held; a case that will arise in a limited offensive or in the later stages of a battle aimed at gradually wearing out the enemy's power of resistance.

The bombardment of *woods* and *villages* should not consist of an indiscriminate shelling of the whole area. The portions that require bombardment, whether because they are to be captured or because they flank the advance, must be definitely determined.

In all cases it is necessary to arrange to prevent by fire the repair of destroyed or damaged defences. In this, as with cut wire, infantry can assist to a considerable degree.
[* See Section III., para. 3, of "Instructions for the Training of Divisions for Offensive Action."]

36. Fleeting Targets.

During the course of the preliminary bombardment, opportunities will occasionally be presented of causing loss to fleeting targets (reinforcements, reliefs, working parties or troops driven from shelter by artillery fire). Certain batteries should,

therefore, be held avail-able on the "zone call" system to engage any such targets located from the air. Arrangements should also be made to extend this system to ground observing stations; so that any observer, seeing a favourable target, can pass information quickly to a selected and suitable battery. There is no reason to retain such batteries solely for this purpose; they can carry out other tasks as well.

37. Accuracy of Fire.

The necessity for destroying definite points in the enemy's organised system of defence demands the greatest accuracy of artillery fire, particularly when the opposing lines are but a short distance apart. The importance of accuracy cannot be over-estimated, and must be constantly ensured by means of definite orders, rigorous fire control, and constant supervision. To this end it is essential to arrange for periodical pauses in the bombardment of each section of the bombarded area, in order that firing may be checked on datum points, the detachments rested, the equipment carefully inspected and minor repairs effected. During these pauses, every endeavour should be made to take air photographs of the hostile area, for these will disclose beyond argument the accuracy of the fire brought to bear and will enable commanders to repeat or to modify their bombardment programme accordingly.

Cases will occur where effect on the enemy's front trenches can only be ensured at the cost of an occasional round into our own trenches. This is a matter of pure ballistics, beyond human influence, and must be recognised as such by infantry commanders. The advisability of withdrawing infantry from their trenches during a bombardment must depend on the local conditions. If the trenches are good and the men keep down, they may be safer in the front trenches than they would be if crowded in support trenches which may be heavily shelled at times by the hostile artillery. If the distance between the opposing trenches is such that some rounds are likely to fall in or short of our trenches, then the trenches must be cleared for the requisite time. The only alternative is to place the "mean point of impact" of the artillery fire beyond the target. This is unsound, as it entails a much reduced chance of achieving the destruction required at a greatly increased cost of ammunition. In view of the consideration that a few of our own heavy shells dropped in a crowded trench, especially just prior to the assault, may prove disastrous to the moral of the attacking troops, it will almost always be advisable to clear our trenches for the sake of an effective fire. The enemy is not likely to rush them in any strength at such a time. It is the duty of the Artillery Commander to make these points clear to the General Officer Commanding; it is the latter's duty to decide. If trenches are to be cleared, it is impor-tant that ample notice should be given to the infantry; in order that they may have time to make the necessary arrangements for temporary evacuation, and for denying to the enemy any opportunity of coming forward out of his trenches to avoid the effects of artillery fire.

38. Forward Guns.

In some cases guns dug in, actually in or close to the front line trenches, may prove of great value for special purposes, such as for making a breach in the hostile parapets or for knocking out machine guns. Provided time is available, experience shows that field guns can be got into almost any position, and that their fire at such short ranges produces a very marked effect. The secret of success lies in the most careful attention to detail. Unless every possible precaution is taken, the gun and detachment may both be put out of action before they have effected their purpose. Although there is no doubt that their presence has a great moral effect, their use must not be overdone, and they should not open fire until just before the assault.

39. Advanced Batteries. Batteries placed right forward to open fire at or after the time of assault are considered in para. 18, Section VI.

40. Character of the Bombardment.

The programme of bombardment must be so arranged as to keep the enemy in a state of uncertainty as to the time when the infantry attack will be launched. The approximate hour of assault should be settled early and not changed. It will then be possible to ensure that, as far as the artillery is concerned, the actual assault shall come as a surprise. The German is peculiarly accustomed to order and regularity, and so it is advantageous to accustom him daily at the proposed hour of assault to a regular routine to which he must conform under pain of suffering casualties. Then, when the real hour comes, there will be a very good chance of letting the infantry into the enemy's trenches by making some slight alteration in that routine.

False ("Chinese") attacks are generally carried out during the bombardment with the object of inducing the enemy to man his parapets and then subjecting him to an intense man-killing fire. The infantry, trench mortars, &c., should participate in these feints so as to give the greatest impression of reality. The lifts for the attack should be practised during the bombardment. Officers must be detailed to watch all such shoots so that thin places in the barrage or inaccurate shooting may be rectified in time. For the former purpose balloon observation may also be employed with great advantage. Further, the results can be corroborated by means of air photographs, and arrangements should be made to photograph each practice barrage. Besides watching our own barrages, steps should be taken to observe and record those put down by the enemy, as much valuable information may be gleaned from this source.

41. The Bombardment of Rearward Lines.

As already stated a vigorous and systematic artillery fire must be maintained over the enemy's back areas up to the limits of gun range, with the immediate objects of inflicting casualties, arresting movement and generally disorganising his supply and other services. This will entail the deliberate destruction of many selected points in the enemy's rearward lines of defence, hut does not constitute a regular bombardment.

The extent to which rearward lines must be bombarded depends on several factors. The ultimate object of the first day's attack, the range to the rearward lines, the number of guns available and the duration of the bombardment all directly affect this question. It will rarely be possible to effect any extensive damage to the enemy's third line, where such exists, owing to the factor of range which limits the number of guns that can reach the objective.

If the attack is to go through to as great a depth as possible, and if time allows, then certain points in the enemy's second line should be selected for destruction on the same principles as govern the artillery attack of the front system of defence. If, on the other hand, the attack has a limited objective, or if the attack of successive objectives, spread over several days, is contemplated, then there can be but little value in any extensive bombardment of the second line. It is not unusual to find that before the assault considerable anxiety is expressed as to the destruction done to the wire and trenches of the second line. The fighting subsequent to the assault, particularly the various barrages, will do much towards opening a way through the second line of defence. It is easy to exaggerate the resisting power of rearward defences and to press for its reduction. But the first essential is to ensure the infantry's passage over the enemy's front line system of defence, and to take any chances in this respect in favour of more distant systems is manifestly indefensible.

42. Duration of the Bombardment.

No definite guide can be laid down as to the ideal length of an artillery bombardment. The underlying factors are numerous and the daily results achieved carry great weight. Hitherto, the moral effect of the enemy's wire has involved organised wire-cutting which in reality means a prolonged bombardment. It is possible, as explained in paragraph 3, Section V., that wire-cutting in the future will be carried out much more rapidly. The time theoretically required to destroy definite objectives depends on their nature and extent, upon the number of fire units available, and on the facilities for observation. If fire is to be conducted deliberately and with careful observation, this period can be calculated with considerable accuracy. Shortening the period may increase the chances of surprise and may so give the enemy no opportunity of bringing up additional artillery. A long bombardment is calculated to reduce the enemy's moral by its insistence, a short one by its intensity. In all cases it is the duty of the Artillery Commander to watch closely the progress of the artillery preparation, making such modifications in the allotment of guns and ammunition as he may consider necessary.

The evidence of photographs, corroborated by the reports of patrols and special observers, is the surest guide to the extent of material damage effected. The effect of the fire should be continuously observed by selected artillery officers and aeroplane observers. "Photographs showing the progress of the work of demolition are taken daily when conditions are favourable, and issued to all Divisional Commanders concerned as well as to the Corps Commander; Divisional Commanders must satisfy themselves that all danger points in their zones are adequately dealt with,

and they should bring to the notice of the Corps Commander any points which, in their opinion, require further treatment. In considering the state of the enemy's defences, as disclosed by photo-graphs, it must be remembered that considerable further effect will be achieved by the bombardment which remains to be carried out between the time that the last photograph is taken and zero hour on the day of attack; and also by the howitzer bombardment which lifts forward from trench to trench from zero hour onwards."*

[*See Section III., para. 3, of " Instructions for Training of Divisions for Offensive Action."]

VI. The Support of the Attack.

43. The General Mission of the Artillery.

Adequate artillery preparation will not alone ensure the success of an attack. The support of the infantry during the attack is at least as important, and in this phase the general mission of the artillery consists of :

. Beating down all resistance to the advance, from either front or flanks.
a. Preventing the assembly and approach of counter-attacks of all sizes.

In a word the artillery must aim at overcoming the enemy's batteries, riflemen and machine guns that have not been destroyed during the preliminary bombardment.

44. Importance of Concealing the Hour of the Assault.

Every precaution must be taken to ensure that the actual assault should come as a surprise. It will probably be impossible to conceal from the enemy the intention of an attack on a large scale. If any indication of the actual hour of assault is afforded (as by an obvious change in the intensity or nature of artillery fire, bayonets showing over the trenches, advancing "tanks," &c., &c.) the enemy's infantry will be in instant readiness to man their parapets, the hostile artillery barrage may come down and the assault may possibly never start.*

If on the other hand no notice is given to the enemy, he will not know until too late exactly where his barrage is required.

[* See Section V. of "Instructions for tie Training of Divisions for Offensive Action."]

45. Barrages.

The barrage system has been lately developed. It must be remembered that, while the following notes deal with the procedure that has recently been the most successful, it is only to be expected that the enemy will devise new methods to defeat our barrage fire. New methods on his part will call for immediate modifications in our artillery tactics.

46. Object of the Barrage.

The object of the artillery barrage is to prevent the enemy from manning his parapets and installing his machine guns in time to arrest the advance of our infantry. It has already been explained that permanent concrete emplacements for machine guns must be destroyed during the preliminary bombardment and that a daily searching of the ground with shrapnel fire is a helpful method of dealing with machine guns sited in shell holes and shallow positions in front of or behind the immediate objective. Machine guns kept in deep dug-outs, or even in deep shell holes if undercut, cannot be destroyed by these means; but on the other hand, a certain period of time is required to bring up and mount such guns. Though this period is not long, it is quite sufficient to enable the attacking infantry to deal with the situation if they are close up under the barrage. The barrage must, therefore, be sufficiently heavy to keep the enemy in his dug-outs and shelters as long as possible, and sufficiently accurate to allow the infantry to get so close to the trench attacked that, when the barrage lifts, they can cover the remaining distance before the enemy can prepare to receive them.

47. The Field Artillery Barrage.

To deal with the enemy's infantry and his variously sited machine guns the Field Artillery Barrage may consist of "creeping," "back" and "standing" barrages applied separately or simultaneously.

The "standing" barrage opens on each objective when it is to be assaulted, with the object of forcing the enemy to take cover and of preventing him manning his defences before the infantry reach the position.

The "back" barrage meanwhile searches and sweeps all the ground in rear of the objective whence rifle or machine gun fire might be directed against the advancing infantry.

Whether in addition to these two barrages a "creeping" barrage will also be required depends on the distance to be traversed by the infantry from their "jumping off" place to their objective. If this distance is such that the infantry is not sufficiently protected by the fire of the "standing" barrage against any machine guns or riflemen that may still lurk in shell holes, then a "creeping barrage" should precede the advancing infantry, with its Mean Point of Impact at a distance of 200 yards or so in front of them, and move forward till it joins the "standing" barrage, when both barrages lift off together. It must, however, be remembered that the simultaneous employment of three barrages is to be avoided on principle, as it entails a maximum dispersion of effort on the part of the artillery available.

In the first assault, a "creeping" barrage will usually be unnecessary, as the distance between the opposing trenches will, as a rule be such that the "standing" barrage will be all that is possible or necessary. In later stages, when the enemy has been forced back into hastily dug trenches, the "standing" barrage may sometimes dispensed with in favour of the "creeping" barrage which can fill the dual role by dwelling for a certain time on each objective to be assaulted. In this case the object of the barrage is to allow the infantry to "follow close up to the barrage from the instant it commences, and then taking advantage of this 'dwell,' work up as close as possible to the objective, ready to rush it at the moment that the barrage lifts." In either case the one essential is that the infantry shall be able to move as close up to the barrage as is possible so that "the time which elapses between the barrage lifting and the infantry entering the trench may be less than that required by the enemy to man their parapets" and install their machine guns. Success or failure is a matter of a few seconds.*

The barrage will meanwhile approach the next objective, picking up the back barrage en route and being organised on a similar system to that arranged for the first objective.

48. Strength of Field Artillery Barrages.

The following figures may be taken as a general guide to the relative strengths of Field Artillery barrages: One 18-pdr gun per 15 yards should provide adequate barrages of all natures. An 18-pdr. "back" barrage does not require a large number of guns; about one-eighth of the total available should suffice.**

[* See Section III. para. 4. of " Instructions for the Training of Divisions for Offensive Action."]

[Where both "creeping" and "standing" barrages have been employed it has been found that the latter has usually consisted of about one-third of the available guns, the "creeping" barrage of the rest, but the proportion must depend on the ground and on the dispositions of the enemy.]**

49. The Organisation of the Barrage.

The barrage lines throughout the corps must be arranged by the G.O.C., R.A. Corps, in accordance with the Corps Commander's directions, after consultation with Divisional Commanders, and are best communicated to subordinate commanders in the form of a map showing all the lifts. No changes should be permitted once the bar-rages have been worked out and issued, except on a change of the general plan of attack.

It is laid down ("Instructions for the Training of Divisions for Offensive Action"— issued by the General Staff, December, 1916— Section 135, page 62, para. 3 (i)), that the front or jumping-off trench must be as nearly parallel as possible to the enemy's front line so that the leading waves may jump off square to their objective. This is of great importance to the placing of the barrage, as the first objective (the

enemy's front trench) can thus be subjected to a barrage from the Heavy Artillery *along its whole length,* and then to an 18-pdr. barrage *followed by a simultaneous assault by the infantry.* Against subsequent objectives, however, it will often follow that the infantry cannot jump off from a parallel line, and in this case the barrage should swing so that it is parallel to the objective along its whole length before it finally lifts on to the objective. Occasionally it may be difficult to execute this "swing" of the barrage; in such cases the alternative method is to arrange for each small section of the barrage, as it reaches the trench line, to stop there until gradually the whole length of the barrage has been built up. In both cases the barrage ultimately lifts off simultaneously; the fact that certain portions of the assaulting lines are kept waiting while the barrage either swings or is built up does not matter. A barrage that remains parallel to the jumping-off line does not keep the troops waiting in the open; but the infantry's arrival on the objective is not simultaneous and, wherever the trench bends, there is an open space between the barrage and the part of the trench occupied by our troops. This may contain the entrance to a dug-out, and it is quite possible that the enemy's machine gunners may receive warning and get their guns mounted in time (see Appendix II.).

50. Pace of the Barrage.*

"(i) The secret of a successful assault rests upon the assumption that the infantry conform their movements exactly to the timing of the barrage. The importance of this timing, therefore, cannot be over-estimated. If the lifts are too quick, the pace will be too fast and the infantry will fail to keep up with the barrage. Once this happens the whole advantage of the barrage will be lost, as the enemy will have time to man his parapet before the infantry reach it. The advance will then be brought to a standstill under close-range enemy rifle and machine-gun fire, while the barrage moves further and further away in accordance with the time table."

"If there is too long a pause between each lift, the pace will be too slow, and the rear waves will push on too fast and become mixed up with the leading waves, thereby forming a thicker line and increasing casualties, besides losing the driving power which a series of waves gives to the attack."

"(ii) It is impossible to lay down any definite ruling as to the best pace; it must be regulated entirely by local conditions." *The great thing is not to go too fast.* The pace must be such that the slowest man can easily keep close up under the barrage. 100 yards in 3 minutes is a good average pace over dry ground pitted with shell holes.

"The state of the weather, the extent to which the ground is cut up by shell fire, the length of the advance, the number of enemy trenches to be crossed, all affect the pace at which the infantry, and consequently the barrage, can move. In actual practice, the pace has varied from 75 yards a minute, when conditions were very favourable, to 15 yards a minute when they were very unfavourable." "(iii) A uniform pace throughout the advance is unsound; at the commencement the pace of the barrage should be quicker, gradually slowing down towards the finish as the

men become exhausted, in order to give them time to get close up to the barrage and to pull themselves together for the final rush."

"In the case of a long advance, it is advisable to keep the barrage on the objective for a double period, in order to make quite certain that the men are closed up and ready to rush the trench."

"Above all, it is essential that in the attack of a more or less intact system of defence the infantry should cross 'No Man's Land' as quickly as possible. To achieve this, it is of vital importance that the infantry should start off at zero time with absolute punctuality, for any delay at this moment may be disastrous."
[* See Section III, paras. 5, 6 & 7, of "Instructions for the Training of Divisions for Offensive Action."]

51. Time Tables.*

"The timing of the barrage is fixed, as part of the Corps Artillery plan, by the Corps Commander after consultation with Divisional Commanders, particular attention being paid to the points of junction between Divisions to ensure that the barrages on each Divisional front overlap properly. The timings worked out are then embodied in a programme or time table and issued to all concerned.

The duration of the barrage depends on the number of objectives to be gained. Where there is only one objective, the barrage, after lifting off the objective, will continue to creep forward till it reaches a line about 300 yards beyond the objective. This distance is necessary to give room for outposts to be pushed out to cover the consolidation."

"The barrage then becomes stationary and gradually dies down, ceasing altogether as soon as the infantry report that they have secured the objective." "When there is another objective, there will be a certain pause, previously arranged and laid down, to enable the troops detailed for the assault of the next objective to get into position; the barrage will then commence moving forward again in accordance with the time table."
[* See Section III, paras. 5, 6 & 7, of "Instructions for the Training of Divisions for Offensive Action."]

52. Control of the Barrage.*

" (i) The control of the barrage remains in the hands of the corps commander throughout the assault, but, in order that divisional commanders may be able to deal promptly with any situation which may arise on their front, they will be given a call on a certain number of batteries (18-pdr., 4.5-inch and 6-inch howitzer) from the commencement of the assault."

"All batteries thus detailed will have tasks allotted to them in accordance with

Corps Orders and will carry them out, unless and until their assistance is demanded by the divisional commander concerned."

"The divisional commander will demand the assistance of these batteries through the commander of all the field artillery supporting his division. The latter officer will have his headquarters at Divisional Headquarters, if possible, and will be in direct communication with all the field artillery groups under him and also with the G.O.C., R.A. Corps."

"(ii) To enable commanders of assaulting brigades to take immediate action in any situation which may arise, the Divisional Commander may delegate to the Brigadiers concerned the power to call direct on some of the batteries placed at his disposal."

"The Brigadier will call on these batteries through the commander of the field artillery directly supporting his Brigade. This latter officer will, whenever possible, establish his Headquarters in the immediate vicinity of the Infantry Brigade Headquarters, but where this is not possible he will maintain the closest touch with the Infantry Brigadier by means of a senior Artillery Liaison Officer."

"The governing factor as to which of these two methods should be followed is to a great extent a question of communications. Unforeseen situations will always arise necessitating the passage of orders and information between a Divisional C.R.A. and his Group Commanders. If the Headquarters of an Infantry Brigade is so placed that communication between an Artillery Group Commander at or near those Headquarters and his Divisional C.R.A. has a reasonable prospect of remaining continuously open, such is the best solution. If not, then the Artillery Group Commander is better represented by a responsible Liaison Officer."

"(iii) Except when minor operations by single battalions are being carried out, it will usually be unnecessary to give officers commanding assaulting battalions the power to call on batteries, and consequently these officers will not require Artillery Liaison Officers."
[* See Section III, paras. 5, 6 & 7, of "Instructions for the Training of Divisions for Offensive Action."]

53. Rate of Fire and Depth of Lifts.

The rate of fire of 18-pdrs. should never exceed 4 rounds per gun per minute and this rate should only be maintained for short periods. The equipment will not stand more.

Field Artillery lifts should be approximately 100 yards at a time. Intermediate lifts must be arranged so that any trenches or works in front of the objective are included in one of the lifts, and so that the final lift brings the fire right on to the objective. Except in these cases lifts of less than 100 yards are disadvantageous, as

time is lost in adjusting the sights, and experience both in the field and on the range shows that at average ranges a 100-yards lift every three minutes completely searches the whole ground.

54. Enfilade Fire.

Enfilade fire is of value in the support of an infantry assault not only on account of its great effect, but also because of the accuracy with which it can be used. If the guns placed in position for this purpose are anchored and carefully registered for line on the enemy's front trench when at extreme traverse, the fire can be moved forward slowly as the infantry assault; but their utility comes to an end as soon as the other limit of traverse is readied. Guns so placed can also be used to form a "cross-barrage," i.e., one formed by guns firing at right-angles to one another, which will ensure some fire from a flank on any route which is attempted through the barrage. Care must be taken in using enfilade fire in support of an attack that there shall be no risk of hitting any bodies of our own infantry on the flank of or beyond those which the guns are immediately supporting.

55. Ammunition for the Field Artillery Barrage.

The barrage has two main properties:

a. It is a man-killing agent.
b. It acts as a screen to cover the movements of the infantry from view.

Therefore shrapnel (with a long corrector) presents distinct advantages for use in a "creeping" barrage under which the infantry has to advance, owing to the high proportion of possible man-killing missiles released by the burst of the shell and to the smoke cloud given off. If a large proportion of H.E. shell is employed, the covering screen will be too thin and the enemy will be able to bring aimed machine-gun fire to bear through the barrage from positions in rear. H.E. shell may, however, prove very valuable to cover attacks on woods and villages.

It is possible that the future may bring about considerable modifications in the method of carrying out barrages in view of the introduction of smoke shell. The use of H.E. shell for the "creeping" barrage may be capable of increase if preceded by a smoke barrage to form the necessary screen; or a mixed shrapnel and smoke barrage may conceivably be found useful, either of these methods releasing l8-pdrs. for the back barrage. H.E. and smoke shell, again, may prove of great use in this latter form of barrage. The employment of smoke shell is, however, still in its infancy, and the above possibilities are only to be regarded as indications of the direction in which artillery thought may ultimately turn.

56. The Howitzer Bombardment.*

At the moment of assault the enemy's artillery is a target of vital importance, and

an adequate number of batteries must be employed to reduce the enemy's guns to comparative impotence. All howitzers not engaged in counter-battery work should begin an intense bombardment of the enemy's trenches, working up lanes in the same manner as the Field Artillery barrage. It depends upon the ground whether this bombardment moves forward just in front of the Field Artillery barrage, or whether it dwells on commanding points in rear within machine-gun range, thus increasing the strength of the back barrage. The moral effect of the former procedure is very great. In either case this bombardment ultimately works forward well beyond the objective and then remains stationary on trenches, hollow roads, woods, villages, &c., where the enemy might assemble for a counter-attack. The effect of this bombardment can be increased if indirect machine-gun fire is brought to bear simultaneously on the areas which are being bombarded, with a view to dealing with any of the enemy who attempt to escape the bombard-ment by leaving their trenches, &c.**

[* See Section III, para. 4 (ii) of " Instructions for the Training of Divisions for Offensive Action."]

[A mixed barrage, that is a. barrage of field and heavy artillery combined, has been found very efficacious as covering fire in the attack of a wood.]**

57. Consolidation and Counter-attacks.

The artillery plan must include arrangements necessary to ensure the protection of the infantry after their ultimate objectives have been gained. At every pause of any considerable length care must be taken that trenches, works, and approaches on the immediate flanks of the general infantry line, as well as areas suitable for the assembly of counter-attacking troops are kept under fire. The extreme flanks, where they bend back to the original line of departure, present an opportunity to the enemy unless they are rendered unapproachable by fire.

A final or "protective" barrage must be maintained beyond the ultimate objective as long as it is required by the infantry (see para. 9).

The rate of fire can gradually slacken, and medium and heavy howitzers need not ordinarily be used after the first hour unless called for; but any attempt to economise ammunition at this period may lead to the undoing of the whole attack. The principles of crushing hostile counter-attacks must be thoroughly understood. It is a critical period for the infantry when they first become exposed to the hostile artillery firing in preparation of the main counter-attack, which will not, of course, ordinarily develop for some hours. The artillery, however good the counter-battery work, cannot prevent the infantry being shelled at this period when distant or even new hostile batteries will probably have come into action and when every hostile gun that can fire will do so regardless of losses. But the artillery, working in conjunction with the Air Service, should be able to prevent the enemy from assembling for a counter-attack. That must be the chief aim of the artillery. If, however, the enemy does manage to launch a counter-attack, then the guns must bring it to a stop.

Directly the enemy's artillery preparation begins, our artillery must fire in counter-preparation. The enemy's batteries must be engaged; a destructive fire directed on his foremost trenches, works, and likely places of assembly; and all approaches and roads, as well as billets, dumps, &c., must be shelled. Fire in counter-preparation must be conducted with an energy and intensity superior to that of the enemy, and last for as long a time. At the first sign of an infantry attack, a strong protective barrage must be at once placed close in front of the infantry through-out the length of the line attacked.

58. Zone Calls.

(See " Co-operation of Aircraft with Artillery," 1916, paras. 22-25.) The Zone Call system has proved its value in battle. Batteries should be specially detailed to answer zone calls and deliver an overwhelming fire on every target notified by this means. The material results are often great, but the moral effect is greater still. The hostile infantry feel that if they are seen moving even in a trench by an airman, a heavy fire is quickly brought to bear on them, and their moral suffers accordingly.

Zone calls from the air have proved particularly useful while the infantry are consolidating under cover of the protective barrage. Targets presented by bombing parties preparing to attack our "stops," local reserves leaving their dug-outs and larger bodies further to the rear forming up for counter-attack, can be quickly and effectively engaged by this means. It is for these reasons that, when arranging barrages, some batteries should always be earmarked to receive and act upon these calls, most particularly at that period when the final objective has been gained.

59. Information and Communication.*

The chief trouble of the artillery is lack of information during the first hours of the battle, for infantry find it extremely difficult to report their exact positions in a shelled country whence all land-marks have disappeared. Reliable communications and constant touch between artillery and infantry commanders are essential to successful co-operation, but difficult to achieve in the actual course of a battle. Every possible means must be considered and utilised where suitable; telephone, signalling apparatus, wireless sets, rockets, flares, light pistols, carrier pigeons, messenger dogs, and, above all, runners. For the first hour or so after the assault, until communications can be well established, the difficulty of maintaining communication between the two arms is felt, and this difficulty increases when the artillery make their first advance.

***Lights.*—During these periods communication will generally be restricted by force of circumstances to calls for barrage fire by means of light signal rockets or light pistols. All such signals from the front line must be repeated back by intermediate stations, if necessary as far as the batteries themselves.**

***Visual Signalling* often proves a valuable adjunct for maintaining communication in**

difficult positions and can be used in combination with telephones and runners. The following system has been found useful: —

60. DIAGRAM

"*Coloured flags,* carried by one or two men in each platoon, can be used to indicate to the artillery the line gained by the leading infantry. These flags must not be stuck in the ground and will mean nothing unless they are waved; the poles should be short and blunted at the end. A combination of black and yellow on a flag about 18 inches square is the easiest to observe." "Flares.—The position of the leading infantry has been success-fully indicated to aeroplane observers (and so transmitted to the artillery) by the lighting of flares at certain pre-arranged times or at an agreed signal from the aeroplane."*

Special *Artillery Observing Stations* have already been mentioned as a means of great value for watching the progress of the infantry. (see para. 5, § IV.).

***Artillery Command Posts* have also been discussed so far as regards their position (see para. 6, § IV.). The work of the heavy artillery is so intimately connected with that of the field artillery that direct communication should always be established between Divisional Artillery Commanders and Commanders of either Corps Heavy Artillery or of Heavy Artillery Groups, according to the artillery plan, so that in the stages subsequent to the assault no time may be lost in rapid inter-communication and consequent action when required.**

***Battery Commanders* must be where they can best see the general situation. Once the attack has been launched this changes so rapidly that there is often no time to receive orders from higher commanders, and battery commanders must be prepared to act instantaneously on their own initiative, of course informing their Brigade or Group Commander of the action taken.**
[* See Section III, para. 8, of "Instructions for the Training of .Divisions for Offensive Action."]

61. The Artillery Advance.

Artillery on the move is for the time being useless and the advance, particularly that of heavy artillery, is a lengthy process unless it has been worked out in every detail.

Continuity of artillery in action can only be obtained if its advance is made by echelons and practically without interruption.

The next positions must be decided, at least approximately, for each brigade or group and the time when it will probably have to move must be considered. In order to assist the necessary continuity of artillery fire, it will often be advantageous to place certain batteries in action close to the front trenches, with the proviso that they do not open fire before the attack takes place. Such positions must be carefully

concealed.

Additional positions in this area may be earmarked, or even pre-pared, for other artillery and should be capable of early occupation. Even if the emplacements cannot be dug, it should be possible to do much towards preparing the artillery boards, communications and approaches. Here again camouflage must be freely employed.

The provisional selection of positions between the trenches or beyond the enemy's front line must be based upon study of the map and air photographs, assisted by personal reconnaissance from observing stations. For all positions that are not constructed before the attack (see Appendix III.), the Artillery Commander and the General Staff concerned must consider the provision of labour. The mass of artillery will have been at work almost unceasingly since the open-ing of the bombardment and, if their fire is to be re-opened after movement with minimum delay, every endeavour should be made to assist the batteries with personnel for labour.

The amount of artillery that is called upon to advance early will of course vary directly as the measure of success attained; but, whatever the number of batteries involved, support of the infantry remains the foremost consideration. As the infantry push well ahead, the first step in their distant support is assured by means of those batteries which have been placed right forward. The first batteries to move will be certain field batteries and a proportion of the more mobile heavy artillery units (60-pdrs. and 6-inch howitzers) which must have been earmarked for this duty. If it is possible to relieve these batteries of any participation in the first phases of the battle, their subsequent movement can be made at short notice. Their routes must have been ordered in advance and improved where necessary. Beyond this again it will naturally follow as a principle that the most retired batteries must be moved forward early, before the battle line progresses beyond the limits of their range and while the more advanced batteries have sufficient range left to cover their movement without unduly weakening the artillery support.

While field artillery is in motion, an increased responsibility will be thrown on the heavy artillery as regards the direct support of the infantry and this also must be arranged for.

Careful organisation is necessary for the proper command of guns pushed forward battery by battery, particularly in the case of heavy batteries. These latter must either be attached to divisions or, if it is desired to retain them under Corps control, may be organised to form a special Heavy Artillery Group under a selected commander.

Appendix I.

G.O.C. R.A. ARMY.

Staff Officer (graded as D.A.A.G.)
Staff Captain
Reconnaissance Officer (graded as Staff Captain)

G.O.C. R.A. CORPS.

Staff Captain
Staff Officer (graded as D.A.A.G.)
Reconnaissance Officer (graded as Staff Captain)

B.-G. C.H.A.

Brigade Major
Staff Captain
Reconnaissance Officer (graded as Staff Captain)
Counter-Battery Staff Officer
Orderly Officer

C.R.A. DIVISION.

Brigade Major
Staff Captain
Reconnaissance Officer (graded as Staff Lieut. 1st Class)

Appendix IV. Ammunition in Relation to Tasks

The following figures may be taken as a rough guide to the amount of ammunition required for the tasks specified under normal conditions and for medium ranges: —

Task	Weapon	No. of Rounds
1. Wire-cutting	18-pdr.	7_ (Shrapnel) + 5% H.E. per yard of front, for a depth of wire not exceeding the 50% zone of the gun at the range.
	2" T.M.	(Fuze Percussion No. 107 - Instantaneous) 1 round per 10 yards of barbed wire. 1 round per 6 square yards of loose wire.
2. Trenches - frontal fire -		
(a) destruction of selected points, averaging 30 yards apart	2" T.M.	100 rounds per point, i.e. 3 1/3 rounds per yard run.
	6" or 8" How.	80 rounds per point, i.e. 2 2/3 per yard run

	9.2" How.	60 rounds per point, i.e. 2 per yard run
(b) total destruction	2" T.M.	5 rounds per yard
	6" or 8" How.	4 rounds per yard/td>
	9.2" How.	3 rounds per yard
3. Trenches - enfilade fire		
	2" T.M.	} allow one half of the above rates.
	6", 8" and 9.2" Hows. 18-pdr.	20 rounds (H.E.) per yard - for total destruction
4. Machine Gun Emplacement	2" T.M.	80 rounds (assuming top cover does not exceed 3' earth)
(roof of 3 rows of pit-props); if stronger use 9.2" Hows. or 9.45"	6" or 8" How.	65 rounds
T.M. only.	9.2" How.	50 rounds
	9.45" T.M.	50 rounds
5. Very strong points (concrete roofs or deep dug-outs)	8" How.	130 rounds per point
	9.2" How.	100 rounds per point
	12" How.	75 rounds up to 9,500 yards; 100 rounds over 9,500 yards
6. Cellars	9.2" How.	8 rounds
	12" How.	4 rounds } per 100 square yards of actual cellar area.
	15" How.	4 rounds
7. Houses	6" How.	12 rounds
	8" How.	10 rounds } per 100 square yards of actual built-over area
	9.2" How.	8 rounds
8. To prevent repair of damaged defences	18-pdr.	250 rounds per 12 hours per 300 yards length of target.
9. Night Firing on communications	18-pdr.	50 rounds per point per hour
	4.5" or 6" How or 60-pdr.	35 rounds per point per hour
10. Smoke Barrages	18-pdr.	2 rounds per 10 yards per minute
	4.5" How.	Groups of 8 shell at 200 yards interval per 2 minutes

11. Gas Shell	4.5" How.	See "Instructions on the Use of Lethal and Lachrymatory
	60-pdr.	Shell"- O.B. 816

20: SS157, Report on the Overseas Artillery School, Salisbury Plain, May 1917

November, 1916-March, 191
S.S. 157, Issued by the General Staff
Source: IWM SS/CDS Pamphlet collection

Opening.

The School opened with the arrival of the first Course on Sunday, 26th November, 1916. The Instructors and Staff had gradually assembled previously at Salisbury in order to arrange a programme of work and receive instructions as to what exactly was to be taught to the Courses.

Range

The new Range, officially known as Chapperton Down Range, occupied a strip of land running almost Southwest from the road joining Tilshead and Lavington, 9,000 yards in length and 2,200 yards wide, so that the centre of the Range was just 2,500 yards to the Southeast of Imber. Contracts were made to hire the land until the end of April.

A permanent telephone system was laid down on the range under the direction of the G.P.O., so that all O.P.s and battery positions were linked up on to one system.

Three main trench systems to represent targets were dug by Infantry, whilst R.E. Companies erected target gun emplacements dispersed by sections or batteries about the range. These served the double purpose of providing targets for shooting, and by a variety of designs testing the destructive power of the different kinds of projectiles.

A large amount of labour and material were expended in this work, and many of the targets are still in existence or can be easily repaired. Splinter-proof observing stations were also built at the same time, and some three or four of them are each capable of accommodating about 70 officers. In addition a survey was made of the range by the Ordnance Survey from Southampton, and excellent contoured maps were produced by that department, both of 1/20,000 and 1/10,000 scales. Artillery boards were also prepared for each battery position, and heights surveyed.

It transpired subsequently that there were some small errors in the survey which became apparent with experience of shooting, and certain corrections were made. This fact showed how all important it is for the survey to be absolutely accurate if satisfactory map shooting is to be possible.

The range is situated 16 miles from Salisbury, the Headquarters of the School, where the Lectures took place, and where the Classes and Staff were billeted. This was a drawback, and considerably more time would have been available for instruction had accommodation been available at Lavington.

In the event of the School re-opening next winter different arrangements regarding housing of Officers, messing, etc., are desirable.

Courses.

Fourteen Courses attended the School, between the dates 27th November, 1916, and 10th March, 1917, a period of 15 weeks. There was one week's break from 14th January to 20th January.

445 Officers of	18-pdr. Batteries.
168 "	4.5" How. "
55 "	60-pdr. "
147 "	Siege "

Total...815 attended the Courses from Overseas.

In addition, some 85 Lieutenant-Colonels and Majors, commanding Artillery Brigades in Divisions at the time in England, and five Artillery Brigadier-Generals. Many visitors, both from Overseas and Home Forces, to the number of 78, also witnessed shooting on one or more days.

The bulk of the Officers in the Courses were Battery Commanders, but many batteries have been represented by subalterns only, which is to be regretted. It was also unfortunate that difficulties of accommodation limited the number who could attend from Home Divisions.

Arrangement of Courses.

Each Course arrived on Sunday in time for a Lecture in the evening, and left either on Friday night or Saturday afternoon.

The Courses were divided up into four parties:

R.F.A., Three
R.G.A., One

R.G.A. AND R.F.A.

The assembling of Officers of both branches of the Royal Artillery together at one School has been beneficial in many ways. But where, as explained below, the instruction aimed at has been mainly of the more scientific kind, it must be admitted that the R.F.A. have reaped the greatest benefits by close association with the more scientific branch.

The standard of technical knowledge in the R.G.A. is very considerably higher than in the R.F.A.

There is, however, just as great need for science in one branch as the other.

The R.F.A. have much leeway to make up, and it is thought that if only for this reason, the more the personnel of the two branches of the Artillery can be mixed together the better.

In the R.G.A. both the equipments themselves and some of the methods for controlling fire tend towards slow work, and if it is realised that more speed might be a great advantage, no doubt it could be obtained. In the Field Artillery two main considerations are responsible for demanding a higher standard of technical gunnery knowledge from Officers :

i. Shooting by the map.
ii. Worn guns and howitzers causing calibration to become universal.

But the need for calibration has been no new discovery for Siege and Heavy Batteries, whereas in the R.F.A. the continuance of siege warfare has only gradually brought Officers—in many cases with reluctance—to admit the possibilities of map shooting and the consequent need (if for no other reason) for calibration.

Whether siege warfare is about to develop into more open operations, or whether it is likely to be prolonged for many months to come, highly technical knowledge on the part of regimental Officers is a necessity if the best value from the equipments is to be obtained. Instruction cannot be imparted satisfactorily except at regular Artillery Schools, and the selection and training of instructors for these is of vital importance to the future efficiency of the Artillery.

Too much reliance is apt to be placed on the value of information and instructions circulated to units. Officers have frequently shewn ignorance of important items of information known to have been issued in writing. Such matters as difference in ranging of projectiles or effect of propellants and similar points concerning ammunition or equipment fail sometimes to reach those whom they most concern. This may on occasions be traced to a failure to recognise the importance of the information concerned, but more often it is due to the lack of an office and facilities for keeping or even reading papers, and, in fact, to the conditions of active operations as a whole.

Instruction.

The duration of each Course was two weeks. The first week was, spent at Shoeburyness in the case of the Heavy and Field Battery Officers, and at Lydd by Officers of Siege Batteries. During this week the instruction was mainly theoretical, particular stress being laid on the value of Range Tables. Lectures were given on equipment, buffers, sights, ammunition, etc., together with a certain amount of practical instruction in the Gun Park regarding adjustment of sights and care of equipment generally.

To many Officers who had not had the opportunity of such instruction previously the first week was of great value, and excellent results were obtained both at Lydd and at Shoeburyness.

A preferable arrangement would have been for both weeks to have been spent at Salisbury, but this was impracticable owing to accommodation and transport difficulties.

The work at Salisbury was mainly practical and out-of-doors, Lectures being held in the evenings, usually between 5 and 7 p.m.

The first point regarding shooting which was impressed on Officers has been the necessity when ranging, whether on a target or on a datum point, of making positively certain that the correct "range" is found. It was shewn that the bracket system is not sufficient, or rather that extensive verification is essential before the correct elevation to place the M.P.I. on the target can be ascertained.

The old traps—e.g., guessing from rounds which are off the line—were exemplified, and endeavours made to ensure that all Officers should in future be on their guard against ranging in such a way as might lead to wrong deductions. What may indeed be called amateur ranging has been specially prevalent in the past in connection with ranging for fuze, both with 18 and 60-pdrs., and it is hoped that improvements in this respect will be noticeable in the future. The main instruction at Salisbury, however, both theoretical and practical, was devoted to the subject of Map Shooting.

Map Shooting in reality embraces the whole of the points of theoretical and practical gunnery, whether advanced or elementary, which confront the Artillery Officer, and efforts were directed to showing to each class that accurate map shooting is in fact an achievement which is within reach of all. The process was progressive, commencing on the first day with a demonstration of 100% zones with the various guns and howitzers.

These demonstrations have proved most instructive, and to some Officers quite a revelation. Many Officers have failed to be impressed with the necessity of including in all calculations the average performance of the gun, and realising in consequence what are the actual limitations of every equipment. Succeeding steps, summarized, are (a) ranging on datum points, (b) methods of keeping records of shoots that have been carried out, (c) application and use of datum points to enable fire to be brought to bear on other targets as practised in the field, (d) process to be followed in order to arrive at a correctly predicted elevation, etc., such that a target located on the map may be effectively shelled without previous registration.

All the precautions that need be taken, the calculations and information necessary, the care required within units regarding the sorting of ammunition; these and all that they entail constitute a big subject for instruction in six days.

But very considerable progress was made, and probably most Officers now realise the power which a Commander possesses of being able at will, either by night or day in favourable circumstances, to shell accurately any target within the zone. It was considered that no extension of the scope of the instruction beyond the above was feasible. All efforts, therefore, were concentrated on what might be termed the scientific side of Artillery Shooting, for which the

Chapperton Down Range offers special and rare facilities.

Royal Flying Corps.

Much useful work was done by a flight of the R.F.C. permanently attached to the School.

Observation of special series was earned out, photographs taken, and trial flights given to a large number of Officers on the course who were anxious to practise aerial observation for themselves.

Armament, etc.

The following types of guns and howitzers formed the armament of the School:

9.2" B.L. Howitzer
8" "
6" "
60-pdr. B.L. Gun.
4.5" Q.F. Howitzer.
18-pdr. Q.F. Gun.

Personnel for the first three were collected from various Depots and were formed into one Battery. Fifty of these men were changed every month, with the idea of training as many men as possible during the time available. This Battery reached a high state of efficiency.

The 60-pdr. Detachments formed a separate party and manned the four guns of which two were new, and two were condemned for wear.

The 4.5" Howitzers, four, and 18-pdr. Guns, six, were supplied as complete batteries by a Division. Both these two units were extremely efficient, and they were difficult to replace when the Division left for overseas. They were succeeded by units training as reinforcing batteries, and the change led for some time to a certain loss of instructional value to the class.

The work at the battery and on the Range was throughout under the supervision of two specially selected Officers.

Experimental Work.

It was not desired to undertake purely experimental work, which is, of course, only properly carried out under expert supervision and with all the usual experimental conditions fulfilled.

It was, however, realised that the firing of a comparatively large number of rounds might lead to the acquisition of much valuable information regarding range accuracy and effect of the various projectiles and weapons.

The following quantities of ammunition were expended during the season:

	H.E.	Shrapnel
9.2" Howitzer	1650	—
8" "	1800	—
6" "	2300	—
60-pdr. B.L.	1100	1800
4.5" Howitzer	9400	—
18-pdr. Q.F.	5200	18800

Calibration.

In the case of Siege and Heavy Batteries, calibration has for a long time been an everyday experience, and the process is well understood. To these Batteries special slide rules are issued which greatly aid the calculations if Officers choose to use them.

But in the R.F.A., owing to the wear of the guns and howitzers and to the somewhat recent development of map shooting, calibration has only lately been recognized as a necessity.

Wear of Guns.

Grouping guns according to wear will be of great assistance, though the disadvantage is that as wear continues it will lead to the perpetual exchanging of guns among batteries.

Nevertheless it should be possible so to distribute them that in any 6 gun battery the best and worst guns should not usually vary in wear by more than about 10/1000 or 15/1000 of an inch.

With a 4.5" Howitzer Battery the condemning limit is .12 inches. In a battery all guns should show a wear measurement varying by not more than 10/1000ths of an inch, and the most worn ones might have reached an amount in wear say of 80/1000ths or 90/1000ths of an inch.

It is understood that endeavours are being made by the War Office and Ministry of Munitions to obtain some definite relation between wear measurement and loss of M.V., which would be of great value and provide a most useful check on calibrations. In the case of howitzers this will hardly be possible, but for guns some figures should be obtainable.

Shooting.

Notes have been forwarded from time to time to G.H.Q., France, recording experiences gained with the several equipments in use at the school, but experience in the concluding weeks has in some cases not confirmed that gained at the commencement.

Speaking generally, shooting with the various equipments has been most instructive, owing to a comparatively large number of rounds being available for shooting under the closest observation in such a way as to gain reliable figures in practice as distinct from theory, both in regard to accuracy and effect.

Several trials have been made to test the accuracy of the adjustment of the charges with all natures. It is found in practice that whereas the adjustment works out fairly well with most lots, occasionally a lot is liable to be met with which will give very divergent results. It is important that this should be generally known, as it is by no means safe to rely on uniform results being obtained with different lots of the same propellant. The various points concerning the effect of projectiles are dealt with in a separate pamphlet.

It has been most instructive to note how the accuracy in practical circumstances compares with the figures which exist in the Range Tables. These latter may be intended only as a guide, but it is extremely important that they should be as accurate as they can possibly be made.

It is probably not always recognised that accurate figures in Range Tables present in ordinary circumstances a too favourable aspect of the case. They are obtained by fire under precise and exact experimental conditions, which in the conditions of war are unattainable.

It is important, therefore, that this should be clear in the minds of those who are concerned with schemes, allotment of ammunition, etc., based on the probability of obtaining hits.

A further interesting feature noticeable during the firing of many rounds is the comparison of the theoretical probability of hitting with the actual results obtained. On the whole, probability figures work out reasonably well in practice, as of course is to be expected. For instance, in firing 100 rounds to show a practical 100 per cent. zone, it has sometimes been found that almost exactly 50 rounds are to be found in the 50 per cent. zone obtained by calculation from the 100 per cent. zone.

On the other hand there are exceptions. It is found that the first five rounds of 100 practically never give a mean which tallies with the mean of the 100.

This fact means that only comparative reliance must be placed on the fall of a group of 4 rounds during ranging. From the investigation of many series it appears that it is about 5 to 4 on the fall of a group of 4 rounds giving a true result as to whether plus or minus of a target, but in the case of the M.P.I. of 5 rounds the chances are considerably against its being found to tally with that of a large number.

From investigation it appears that it is necessary to fire some 20 to 25 rounds in order to be reasonably sure that the M.P.I. has been found correctly. The greater the mean error the more desirable it is for plenty of rounds to be fired in order to arrive at the mean. This applies specially to Time Fuzes

21: Internal GHQ memo on limited attacks, 26 June 1917

Source: WO 158/20

SECRET

[holograph notes by L. E. Kiggell: Read by C in C
4 copies: 1 CGS

1 to MGGS Fifth Army (see Fifth Army copy for remarks by Gen Sir H Gough)
1 to Gen Charteris
1 Fifth Army file]

C.G.S.

I am of the opinion that in the operations of the Second and Fifth Armies which are shortly to take place we should not attempt to push infantry to the maximum distance to which we can hope to get them by means of our artillery fire, our tanks, and the temporary demoralisation of the enemy. Experience shows that such action may, and often does, obtain excellent results for the actual day of operations, but these results are obtained at the expense of such disorganisation of the forces employed as to render the resumption of the battle under advantageous circumstances at an early date highly improbable.

An advance which is essentially deliberate and sustained may not achieve such important results during the first day of operations, but will in the long run be much more likely to obtain a decision.

By a deliberate and sustained advance, I refer to a succession of operations each at two or three days' interval, each having as its object the capture of the enemy's defences, strong points, or tactical features, to a depth of not less than 1,500 yards and not more than 3,000 yards.

The operations of the first day will probably produce demoralisation and confusion on the part of the enemy, but such demoralisation and confusion are of a purely local and temporary nature and can only be exploited in a local and temporary manner. The enemy, if then allowed several days to reorganise, will again present a firm front with fresh troops and additional guns, and our task will be more difficult partly owing to our disorganisation due to the first attack and partly owing to the difficulty of the exact location of our own troops and the positions of the enemy.

It appears to me to be of the first importance that we should be able to deliver our successive attacks at not more than three days' interval, and that each advance should be regulated so as to admit of this.

It has been proved beyond doubt that with sufficient and efficient artillery preparation we can push our infantry through to a depth of a mile without undue losses or disorganisation, and I recommend strongly that the operations for the capture of the PASSCHENDAELE - STADEN Ridge should be conducted on the principle of a series of such operations, following one another at short intervals in such a manner as to avoid at any particular period wholesale reliefs, wholesale displacement of artillery, and the wholesale hurrying forward of guns, troops, ammunition, and supplies over ground which is practically devoid of communications.

The Germans will bring forward their reserves to stop our advance whether the latter is rapid or deliberate. It appears to be much more advantageous to us to accept battle with and engage those reserves when we are in an organised state, our guns in position, our troops not tired, and our communications in good condition, than to engage them in some more forward position where we have none of the advantages referred to. We shall not be in a position to obtain a victory or exploit success until we have thoroughly demoralised the enemy and defeated at all events the first series of divisions which he will bring up as reinforcements to the battle. This cannot be done on the first day and should not be attempted.

In considering the manner of carrying out the operations as recommended above, the following points require close study:

1. Communications.

   In order to carry out offensive operations successfully against an enemy whose reserves have not been defeated and demoralised we require to have good communications, both for purposes of troop movements and for supplies and ammunition. Roads and light railways must be constructed. It is not possible to do this at a very rapid pace.

2. Displacement of Artillery.

   In order to give the enemy no rest and to preserve continuity of artillery action, there must be no great displacement of artillery on any one day. The majority of the guns must always be in action. The displacement must therefore be gradual. Any abnormal displacement of artillery dislocates the whole mechanism of movement, supply, and the construction of communications.

3. Continuity of Artillery Action.

   There should be little or no diminution in the action of the artillery. When the preparation of the first operation is completed and the assault is delivered the destructive preparation of the next zone will be commenced at once. For this purpose it will be advisable in each phase of the operations, so far as the ground will permit, to have guns well forward and masked. A certain amount of displacement of artillery will always be proceeding. As soon as the objective on the first day has been reached, such artillery as it is necessary to move will be moved forward and the necessary preparation and registration commenced at once.

The destructive counter-battery work will be continued unceasingly and without any pause. Neutralising counter-battery work will be more limited.

4. Intensity of Artillery Fire.

There will not be such long periods of intense barrage fire. This should materially help to save gun lives, the wear and tear of personnel and the formation of abnormally large dumps at the guns which have proved such a source of danger. It will be necessary only to keep up the intensity of barrage fire during the period of attacks, which will be comparatively short.

5. Concentration in Artillery preparation.

Since the zone of preparations will not be so deep, the artillery fire for the purposes of destruction will be more concentrated.

6. Line of departure.

The line of departure in each successive step of the operations must not be ragged, that is to say, the objectives on any day of attack must be fully reached. It often happens that, if the advance of the infantry is ragged, it is not only difficult for the infantry to start forward to a fresh attack but it is also impossible for the Field Artillery to put down a satisfactory barrage. The best means of securing a good line of departure for the next operation is to ensure that the infantry are not pushed too far and that the objectives are well within their reach.

7. Casualties.

A large proportion of the casualties which are incurred are due to the density of the infantry which is necessitated by the intention of penetrating the enemy's position to a great depth. The less the depth to be penetrated, the less the depth of the troops required. Divisional Reserves instead of being close up can be kept at some distance, immune from losses and fresh for the next effort.

8. Reliefs.

With short and frequent advances, reliefs of large formations will be avoided. This is an important factor and one which will reduce disorganisation and confusion, and ensure continuity of action by avoiding the long delays which are inseparable from wholesale reliefs.

9. Morale of the troops.

The less the depth to which attacking troops have to penetrate at the outset of the operations, the greater is the confidence of the troops in their ability to reach their objectives, and the fewer will be the casualties. These facts tend to raise the morale of the troops since they feel confident of succeeding in their task.

10. Sustained nature of the fight, the cumulative effect on the enemy's morale, and the possibilities of eventual exploitation.

By the means described above the fight can be sustained under conditions which are entirely to our advantage. The enemy will be allowed no respite. The first day's operations, which will probably aim at the capture of the enemy's second line of defence, will throw him into a state of disorganisation and destroy a considerable portion of his forces. Our experience shows that the enemy does not recover from this state of partial demoralisation for a period of two or three days; if, therefore, we are in a position to deliver a second and well organised attack during that period we shall already have secured very great advantages. These advantages are likely to increase as the process continues. The great danger of missing the advantages gained by a local and temporary disorganisation of the enemy lies rather in the serious delays which are inseparable from over-reaching our strength and our organizing capabilities on the first day, than in the failure to carry out a local and temporary exploitation of our initial success.

By the process described above and by a succession of successful operations deliberately planned and deliberately executed, there should come a moment when we will be justified in taking risks. Such risks should not, however, be undertaken until we have positive proof of the enemy's demoralisation, which must be of more than a local and temporary character. The character of the enemy's demoralisation will probably change and become more evident with the congestion and intermixture of his troops and the disorganisation in rear. Rapid and effective blows struck at him one after the other at short periods are likely to destroy his troops at a far greater pace than spasmodic efforts. It is the pace at which we can destroy the enemy's troops that will cause the greatest disorganisation in his rear by congesting the areas with defeated troops and necessitating the hurried arrival of reinforcements on his railways.

11. Tanks.

The most satisfactory period for using tanks is that in which we are operating over ground which has not been destroyed by shell fire, when the enemy is partly demoralised, when his artillery arrangements are disorganised and when he has not been able to establish his anti-tank defences. With the exception of a few tanks which may be used at the outset of the operations for the purposes of rounding up pockets, etc., the bulk of the tanks should be reserved for use against the enemy during the later stages of the battle, when we are beginning to feel ourselves justified in taking risks.

12. Cavalry.

No success can be complete without the use of cavalry to exploit and reap the fruits of victory. Cavalry cannot be used in numbers effectively until the enemy has been thoroughly shaken and demoralised, and until such disorganisation and demoralisation is of more than a local and temporary nature.

By a series of rapid and effective blows dealt against the enemy's reserves under our own organised artillery fire, that is to say, by sustained and deliberate action, allowing the enemy no time for reorganization, and by the use of tanks in large numbers during the later stages, we may reasonably hope to produce a situation when the cavalry can be employed in large numbers and with decisive effect.

[signed] J. H. Davidson
Brig.-General, G.S.
26/6/17

22: Attack Barrages As Modified By The Enemy's Latest Tactics, 25 August 1917

Source: Maxse Papers, IWM, file 35/3

G.O.C, R.A. Fifth Army letter RA/225

1. As far as can be gathered, the comparative failure of many attacks at present is caused by one of two causes, viz:
    a. The hostile counter attack delivered shortly after the objective is gained, causing our Infantry to fall back.
    b. M.G. fire during the advance from one objective to another and while consolidating on preliminary objectives causing our Infantry to check, allow the barrage to run away from them, thus losing all its protective value. The first cause can be remedied by improvement in Infantry training. As regards the latter cause, a modification in our present Artillery methods may enable us to deal with the matter.
2. As far as this Army is concerned there appear to be two essential differences between last year and this year.
    a. The enemy's M.Gs. have been increased since last year but probably not in much greater proportion than the Artillery which on our part is available to deal with them, provided we recognise the principle that obliteration of trench lines is of minor importance as compared to anti-machine gun work.
    b. M.Gs. are no longer kept chiefly in deep dugouts with only a proportion in shell holes. The deep dugouts we met with last year were chiefly in the various trench line objectives, and the capture of these objectives stopped the bulk of the M.G. fire at once.

This year the dugouts are shallow and small; hence the M.Gs. can be brought out very much more quickly and the team is not impeded by the Infantry of the trench garrison trying to get out at the same time. The M.G. shelters are moreover, chequered all over the country side.

3. These shelters are so small and so numerous that it takes up much time and an enormous expenditure of ammunition for them all to be destroyed. In some cases they are so strongly constructed that with the means at our disposal it is extremely doubtful if we can destroy them at all. The shell craters created round them all probably in practice counterbalance the value of the few actually destroyed.
4. Troops suffer from M.G. fire for two causes:
    a. Failure to keep so close up to the barrage that the enemy machine gunners can be shot or bayonetted before they can get their gun into action.
    b. M.Gs. placed in depth behind our attack barrage, and firing through the barrage, often from a flank.
5. Failures have undoubtedly occurred from both causes during the recent battle—from the first cause partly owing to the fact that the whole country has been so shot to pieces that it is extremely difficult to keep any sort of formation over the

cratered ground, especially so when the shell holes are filled with water.

It must be realised that this year the attacking Infantry must keep even closer to the barrage than last year, since it now takes less time for the hostile M.G. to get into action after our barrage has lifted off it.

Troops who are not prepared to suffer a certain proportion of casualties from our own barrage incur the gravest risk of being decimated by machine gun fire.

The first cause then is again a matter of Infantry training.

6. To turn to the second cause, a great point has been made this year of counter battery work, and rightly so; but without relaxing in any way whatsoever the vigour and determination with which this work is carried out during the preparatory period it is possible that a waste of power takes place during the actual period of attack.

Our universal experience in past and present battles has been that the hostile artillery may be dangerous when

a. Troops are forming up, if the intention to attack is discovered by the enemy.
b. Possibly during a long halt on a subsidiary objective if the enemy has time to find out where our own and his Infantry are.
c. When we have reached and settled down on our final objective.

The occasions when he has been dangerous during the progress of the actual attack are exceedingly rare, particularly if such attack is on a large scale. Incidentally, on these occasions, it will generally be found that the C.B. work during the preparatory period has been ineffective.

7. The M.G. however, is exactly the opposite. It is dangerous only during the advance and during the preliminary stages of consolidation.
8. Therefore, from about zero plus 15 minutes onwards until such time as our troops have established themselves finally, it would appear that a large proportion of the counter battery guns and a certain number of the howitzers should now be put into the barrage in order to give it both strength as well as depth. Our barrages at present are deep, but the more advanced portions are apt to be weak.
9. These counter battery guns will return to counter battery work as soon as the Infantry have reached and established themselves on the final objective.

It will probably be advisable to bring them temporarily back in this manner during the final stages of a long halt on a subsidiary objective. This can be worked out on a time table if found necessary. A forward counter battery O.P. should be established wherever possible.

This O.P. should be sited where the subsidiary objective can be seen, and the Officer in charge, specially selected for the purpose, be made responsible for reporting at once if the hostile shelling on the subsidiary objective in his opinion was sufficient to warrant the withdrawal of the counter battery guns back to C.B. work. This will be a difficult matter owing to it being often very hard at times to distinguish between the enemy's shell and our own, and consequently the officer in charge should be selected for his general reliability.

10. The attack barrage will then be organised in depth in four zones, which for descriptive purposes may be called:

No. 1 The main creeping barrage.
No. 2 The "Combing" barrage.
No. 3 The "Neutralizing" barrage.
No. 4 The "Standing" barrage.

11. The "Creeping" barrage will follow normal lines as at present and consist of the major proportion of the 18-pounders.

12. The "Combing" barrage will consist as at present of the 4.5" Howitzers and a portion of the 18-pdrs. be placed as at present in advance of the "Creeping" barrage, and while dwelling on strong points working up communication trenches etc., be at the same time organised in depth.

The fire should not follow an even cadence and should not lift in regular lines, but be so manipulated that a hostile machine gunner is unable to realize that a lift has taken place and the last shell of the barrage has passed over him.

13. The "Neutralizing" barrage will similarly be organised in depth (from 500 to 1,000 yards), will consist of the 6" Howitzer with non-delay fuzes and the larger proportion of the available 60-pdr guns, and will search the ground behind the "combing" barrage. This fire will similarly be irregular. Its main object will be to search out and neutralize all distant machine guns that may be placed to fire through our "creeping" barrage once the advance has begun.

Special attention must be paid to localities from which flanking machine gun fire can be brought to bear over our front of attack.

All the three foregoing barrages will roll back according to a time table, the main principle being that there should always be searching fire up to 2,000 yards in front of our advancing Infantry.

14. The "Standing" barrage will be to search out for and break up any formed bodies of enemy troops held back for immediate counter attack.

With this object it will from its commencement be placed well back beyond the final objective and come down on all valleys, ravines, woods, hutments, etc., in fact all areas or localities likely to shelter formed bodies. A close study of the map and of the enemy's general dispositions will be necessary in order to place this barrage correctly.

Pin point shooting is unnecessary and persistent and continuous shelling of any one spot (except in case of it being desired to deny the use of some particular route) is useless as the enemy merely avoids that spot—the fire should "search" and "sweep" definite areas.

15. The barrages should search all ground whether seen or unseen as an indirect M.G. barrage may be nearly as dangerous as an aimed one.
16. If, as appears to be the case, the enemy put their machine gun fire just this side of our creeping barrage it may be advisable to make No. 1 (Creeping) barrage into a double one with one-third of the 18-pdrs. 200 yards in front of the other two-thirds. This with a view to inducing the enemy to mistake the front one for the real one close behind which the Infantry are advancing.
17. Each operation must, of course, be treated on its merits and a varying distribution of guns to the different barrages and also of the depth of the barrages be made in each case according to local circumstances and the accuracy and extent of the information available as to the enemy's dispositions.

(sd) H. UNIACKE, Major General
G.O.C, R.A., Fifth Army
25th August, 1917

23: General Principles on which the Artillery Plan will be drawn, August-September 1917

Source: WO 158/208 with material from Appendix XXIII in OH 1917, vol. 2

Second Army.
G. 140
29th August, 1917.

Preliminary Bombardment.

I. To break down obstacles which are impassable for Infantry, but in doing so to create as few new obstacles in the way of shell craters as possible. To bombard strong points.

II. To isolate from the rear the enemy's batteries and front systems, so that he cannot bring up ammunition or replace guns and cannot bring up food or stores without suffering serious loss. To keep him short of food. To reduce his morale.

III. To teach the enemy to lie at the bottom of his shell holes or dugouts whenever any barrages are going on. After one barrage has passed over him he must always expect others. In doing this, cause as many casualties as possible to reduce his morale. This will be effected by working a succession of dense creeping barrages of every available nature of gun and howitzer over the whole area to a depth of 2000 yards beyond the last objective.

IV. To carry out observed destructive shoots on hostile batteries from now on. As soon as batteries are isolated vide II above, to begin intense C.B. work.

Attack.

V. The attack will be made behind 5 barrages which will cover a depth of about 1000 yards.

VI. Immediately prior to and during the attack all known hostile battery positions will be neutralised.

Protective Measures After Gaining the Objective.

VII. Barrages to a depth of about 800 yards will be prepared beforehand which can be put down when the enemy counter attacks, and arrangements will be made for all or any portions of these barrages to creep forward so as to embrace the whole of the enemy reserves.

TABLES ATTACHED.

Table A shows the amount of Artillery which is considered necessary.

Table B shows the amount of ammunition which it is estimated will be required.

Table A

	H.A. Groups	**Guns**									
1st ANZA & X Corps Fronts		12" gun	9.2" gun	6" gun	15" how	12" how	9.2" how	8" how	6" how	60-pr	Bdes R.F.A.
Counter Battery Work						8	52	44	80		
Barrage and Bombardment					2		28	28	112	126	33
Communications										48	
IX & VIII Corps Fronts						8	16	24	48		
Counter Battery Work											
Barrage and Bombardment											15
Communications			1	4						30	
	35	1	3	20	2	16	96	96	240	204	48

On the Active Front

The number of 12", 9.2" and 8" Howitzers is calculated to deal with 440 hostile gun pits + a 25% increase making 550 in all (inclusive of the IX Corps front) on the basis of a 7 day bombardment.

6" Howitzers are required in addition for neutralization of some 40 battery positions.

The heavy artillery barrage and bombardment guns are calculated on a scale of:

60 pdr. :1 gun to 60 yards
6" How.:1 " " 70 yards
8" or 9.2" How.: 1 " " 150 yards

For back communication in addition:

60 pdr.: 1 gun to 166 yards
6" gun: 1 " " 500 yards

If sufficient 60-prs. are not available 6" Hows. might be substituted gun for gun or 18-prs. in proportion of 2 18-prs. to 1 60-pr.

If sufficient 8" or 9.2" are not available substitute 6" How.

Table B

	18 pdr	4.5" how	60 pdr	6" how	6" gun	8" how	9.2" how	12" how	15" how	9.2" gun	12" gun
7 days bombardment per day	200	150	160	200	80	160	120	60	30		
7 days =	1400	1050	120	1400	560	1120	840	420	210	225	180
Z day	450	350	200	300	120	240	180	90	50		
Night Z/A	500	300	250	300	120	240	180	90	60		
Total rounds per gun	2350	1700	1570	2000	800	1600	1200	600	320		
Number of guns	864	288	204	240	20	96	96	16	2	3	1
Total Rounds	2030400	489600	320280	480000	16000	153600	115200	9600	640	675	180

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Additions of 14 September 1917

[1-4 deal with ammunition allotment and distribution]

Counter-Battery Work

5. From now on the hostile batteries will be systematically destroyed by observed fire from the air or ground.

6. For 7 days prior to the attack intense counter-battery work and isolating fire will be carried on. Every means of observation should be used to its utmost capacity and concentration shoots should be carried out when means of observation are not available.

7. The hostile batteries will be neutralized with gas shell (if weather conditions are suitable for their employment) for the four hours immediately preceding zero hour on the day of attack. If weather conditions are not suitable for use of gas shell, H.E. or shrapnel will be substituted.

The hostile batteries will be neutralized with gas shell (if the weather permits) in a similar manner from 2 a.m. to 6 a.m. on C Day, i.e., for the four hours immediately preceding the second preparatory barrage on the whole Army front. H.E. or shrapnel will be substituted if weather conditions are unsuitable for gas shell.

During the preparatory barrage which starts at 6 a.m. on C Day the enemy batteries will be neutralized to the same extent as they will be from zero hour on the day of attack.

8. Preparatory barrages and any necessary bombardment will be carried out during the five days preceding the attack.

9. Isolating fire will be carried out by day and night throughout the whole period. The approaches to the front systems and the hostile batteries will be closed by two tiers of fire.

The field artillery and machine guns will deal with the area up to a range of 6,000 yards from their battery positions, the 60-pdrs. and 6-inch guns supplemented if necessary by some 6-inch howitzers will keep all approaches beyond the hostile batteries under fire. As a rule the ammunition allotted for isolating fire will be expended two-thirds by night and one-third by day, but when the weather is such that the air service cannot keep the approaches under observation the amount fired by day must be increased. Arrangements will be made by Second Army for crossing the fire of adjacent corps on such back approaches as can be enfiladed by this means.

10. On the first day of bombardment communication trenches will be blocked by knocking in a length of about 10 yards; places which are under observation from O.P.s should be selected for this purpose when possible.

11. Wire which is known to exist will be cut early in the bombardment.

12. Known machine-gun emplacements and strong points will be bombarded by the heavy artillery using delay action fuses.

13. Telephone exchanges will be destroyed.

14. The morale of the enemy will be reduced by frequently passing a succession of barrages over his shell hole system and dug-outs instead of by the bombardment of trenches. For method of using these barrages see Appendix II attached. [not reproduced]

15. All known hostile O.P.s should be destroyed not later than two days before the day of attack.

16. Gas shell should be used against the hostile battery positions and on shell holes, dug-outs and localities which are believed to be occupied when atmospheric conditions are favourable. They should also sometimes be used in the last portion of a barrage. Gas shell should always be preceded by H.E., the proportion of gas shell being gradually increased.

The Attack

17. The infantry will advance under an 18-pdr. barrage which will be preceded by at least 4 other barrages on the principles indicated in Appendix I attached. [not reproduced] If considered desirable the 18-pdr. and 4.5-inch howitzer barrage (B) and the machine-gun barrage (C) can be combined and readjusted to form 2 mixed barrages in lieu of the method shown. If greater depth is required the several barrages may be as much as 300 yards apart instead of 200 yards. From the moment the attack commences every battery position believed to be occupied will be neutralized. As many planes as are available and can be employed without jamming should be used for

sending down zone calls throughout the day.

18. The rate of fire of 18-pdr. guns for the first two minutes will be increased to four rounds per gun per minute: during the pauses in the advance it will be one round per gun per minute. The barrages will be thickened by smoke shell if necessary.

19. In cases where high ground within 2,000 yards of the objective has considerable command over the ground that the creeping barrages will traverse such as the Zandvoorde Ridge, it may be necessary to keep this high ground under fire, withdrawing the necessary guns from the barrages.

20. The field artillery should be so allotted to barrages that about one-third can be withdrawn at any moment without making a gap in the barrage, to deal with LL and G.F. calls and fleeting opportunities. The same system should be adopted in the heavy artillery with 60-pdr. guns and 6-inch howitzers.

21. Protective barrages in depth should be prepared beforehand. In addition to a barrage along the whole front, more concentrated barrages should be arranged to be put down on certain areas over which a counter-attack may be expected.

Fuses.

22. The proportion in which fuse No. 106 will be supplied is 50 per cent. of No. 106 and 50 per cent. delay for all 6-inch howitzers, 8-inch howitzers and 9.2-inch howitzers. As few No. 106 as possible should be used for C.B. work and in bombardment in order that as many as possible may be available for barrages. 23. With the 18-pdr. 50 per cent. of the ammunition will be H.E., the fuses for which will be 25 per cent. with delay and 75 per cent. without delay.

Liaison

24. Field artillery and infantry A senior officer of the field artillery supporting it should live with the headquarters of each attacking infantry brigade. Field artillery liaison officers should also be attached to headquarters of each assaulting battalion. Heavy artillery and division commanders

A heavy artillery officer not below the rank of major from the Bombardment Group which is covering the divisional front should live at divisional headquarters with a direct telephone line to the Bombardment Group and through this Group to the Counter-Battery Office.

Heavy artillery with R.F.C.

A senior officer of the heavy artillery should live with the corps R.F.C. squadron.

Resting Personnel

25. Very careful arrangements must be made to give the personnel of batteries sufficient rest throughout the operations.

Protection of Ammunition

26. The protection of ammunition from weather is most important.

27. Acknowledge.

[signed] C. H. Harington,
Major General,
M.G.G.S., Second Army

24: SS592, Catechism for Heavy and Siege Artillery Subalterns, October 1917

Issued by the General Staff, 1917
Source: IWM SS/CDS Pamphlets collection

PURPOSE OF "HINTS."

As an Officer in the R.G.A. you are required to have an extensive knowledge of a number of subjects. On the action you take, due to your knowledge of these subjects, will depend the accurate shooting of your battery and the lives of your men.

This pamphlet consists largely of questions which, if you are an efficient officer, you will be able conscientiously to answer satisfactorily. If you cannot answer them, you are not efficient, which means that you may be responsible for the lives of infantry, whom it is the whole of your work to assist, to say nothing of the lives of your own men.

Take the necessary steps immediately, therefore, to be able to give satisfactory answers to those questions which you cannot answer at present.

I. GENERAL.

1. When your battery takes up a new position do you make every effort to get your guns into action, lines of fire laid out, and the battery connected to an O.P., or to another battery which can observe for you, as soon as possible, so that you can take part in event of a sudden attack?
2. Are you careful that all tracks and conspicuous objects are cleared away before a hostile aeroplane can see them?
3. Do you set about making rough dug-outs for the men immediately?
4. Can you get a round off on your night-lines inside two minutes from receiving the order, day or night?
5. Can you get a round off on to any target in your arc inside five minutes, day or night?
6. Do you take advantage immediately of any fleeting opportunity?
7. Are you careful to keep your group in touch with any change in the situation as soon as possible?

II. THEORETICAL KNOWLEDGE OF GUNNERY.

8. Why is a recoil mechanism necessary?
9. Why do you need to calculate angle of sight?
10. What is the actual effect of making a mistake of 10 minutes in the angle of sight at a range of 6,000 yards with your gun?
11. If your battery uses shrapnel, what is the effect of a graze burst, and of a very high burst?

12. What is the effect on range of a low air temperature, a high charge temperature, or a high barometer, and why?
13. What is "drift?"

III. PRACTICAL GUNNERY.

(The majority of this applies particularly to Section Commanders.)

14. Have you got copies of hand-book, drill-book, and range table for your weapon?
15. Could you have any weapon taken completely to pieces and assemble it again?
16. If it is necessary to replace damaged parts, could you show your men how to do it, if they did not know? How long would it take you to replace the different parts of your gun (or howitzer) that are liable to be damaged or go wrong?
17. What is the weight of your shell, the weight of the charge (or charges), what do the marks on your shell mean?
18. What fuzes do you use? Are you always certain that the bottom of the fuze or gaine is pressing hard against the exploder of the shell?
19. What precautions do you take to keep your ammunition in good condition (particularly with N.C.T.)? Charges and fuzes must be kept dry, and as far as possible at a uniform temperature. Shells must be kept dry, clean, and off the ground.
20. Do you arrange your charges and time fuzes into lots, and your shells into groups according to their weight?
21. Do you take precautions to use up the old ammunition in the pits before that which is dumped when you fill up?
22. Do you know how much ammunition is in your pits at this moment, and how long it would last you in event of an attack?
23. Do you know how long it takes for fresh ammunition to come up during an attack when the roads will be crowded and possibly under shell fire? Accordingly, do you know for how long you could maintain a definite rate of fire before you ought to send for more ammunition?
24. Have you a definite plan for the replenishment of ammuni-tion, so that the wagons know where to drive to and the men know where to put the ammunition when they unload it?
25. Do you know the aiming points used by your guns?
26. Do you keep a board fixed in the gun pit detailing the aiming point and different angles, elevations, fuzes, charges, etc., for your principal targets and defence lines?
27. Could you, at this moment, go and lay your gun yourself on some point within your range and arc?
28. Is your arc of fire as large as possible?
29. Could you determine the map position of your battery in an area of country you did not know?
30. How would you lay out the original line of fire in the following cases:

a. Where there are plenty of aiming points and you know your map position.
b. Where there is no suitable aiming point and you know your map position.
c. Where there is no suitable aiming point and you don't know your map position.

31. What is the effect, if you have got your battery position plotted 300 yards N.W. of your true position, when you switch on from one target to another?

32. Are you certain, at the present moment, that your sights, clinometer, etc., are in accurate adjustment? Do you frequently test this personally?

33. Are you certain, at the present moment, that the bores of your guns are absolutely clean, and all working parts in good adjust-ment and well oiled, and all unpainted parts polished? Do you personally examine the working parts of your guns to see that there is no dirt in them?

34. Do you realise the damage that can be done to the bore by a gun being left loaded for some hours after it has been fired several times and is accordingly coated with corroding substances?

35. Do you turn your wheels daily so as to change the working spoke?

36. Have you got a 'planchette' map board for your battery position? (The 1st Field Survey Company supply these on demand). Is the map of the latest edition? The co-ordinates of points and trenches vary considerably on different editions.

37. Do you occasionally check your map to see that it has not stretched and is giving you wrong map ranges?

38. Are you deficient of any stores, particularly the new stores not in your G.1098, but authorised in various G.R.Os.?

39. If you have emplacements, are they white-washed inside? Are all the necessary tools hung up neatly in the gun pit? Are the box respirators handy?

40. Do you frequently look to see that your buffers are full and your springs and parting plates in good condition? Do not leave this to the Armament Artificer.

41. Do you frequently watch your guns while they are firing to see that the recoil and run up are normal?

42. If you suspect anything wrong with your guns do you request that the I.O.M. shall examine them?

43. Do your aeroplane look-outs know their job? Do you arrange for them to go to neighbouring anti-aircraft batteries occasionally, in order to learn new types of hostile aircraft?

IV. OBSERVATION.

44. Do you know the details of the enemy country your battery is shooting over? Can you name all the prominent points that can be seen from your O.P.?

45. Do you know exactly where our front line is?

46. Do you understand "contours" and can you determine from them what ground should or should not be visible from your O.P.?

47. Do you visit other H.A. and R.F.A. O.Ps. and study the country from

a different point of view?

48. Have you got a properly mounted map at your O.P. with an arc view on it? (The 1st Field Survey Company will supply this on demand).

49. Do you continually instruct all your observation party in knowledge of the country? As this knowledge depends on a purely personal factor, viz., "eye for country," you will generally find that there are several men in the battery who are better at spotting shell bursts, working parties, gun flashes, etc., than you are. Do you make all the use of these men you can?

50. Do you thoroughly appreciate the fact that, whoever is watching from the battery O.P., be it the B.C., or a gunner in the Observation Party, is nominally commanding the battery and must call it into action instantly if necessary, get it shooting, and then make his report?

51. If you see a target out of your arc, do you know whom to call up to engage it, and how long it takes them to shoot?

52. Have you an instrument to measure angles with at your O.P.?

53. Do you check the variation of your prismatic compass?

54. Is your O.P. constructed on one of the following principles?

    1. Overhead-cover proof against 5.9", with telephonists dug-out proof against 8".
    2. Overhead-cover just proof against shrapnel with a 5.9" proof dug-out into which the observer can slip instantly. Telephonists' dug-out proof against 8".

The former used where there is natural concealment, or where concealment is not necessary, and the latter where concealment is essential.

55. Do you inspect your O.P. each day to see that the telephonists' dug-out is kept clean? Telephonists at O.Ps. are inclined to acquire dirty habits.

56. Do you make a point of learning some more country from the map each time you are up at the O.P.?

57. Have you a general knowledge of country both sides of the area your battery shoots over?

58. Do you know all depressions or other places within reach of your battery where the enemy could assemble unobserved?

59. Do you know what rocket signals are used on the front within your arc of fire, and what they mean?

V. RANGING.

60. Can you range your battery quickly on any point in your arc?

61. Do you know how many yards of range or minutes of line a degree represents when looking from your O.P. on different parts of your arc?

62. Do you employ a stop watch when ranging so that you can pick out your own shell if more than one battery is engaging the same target?

63. Can all your Observation Party carry on ranging the battery in case you are a casualty?

64. Do you thoroughly understand the method of ranging with aeroplane

observation?

VI. ACTION.

65. You may be confronted at any moment by an exigency such as a gas attack, a heavy bombardment of your battery, or even a rapid German advance.

66. In each of these cases what action would you take? Have you taken all the precautions necessary to ensure that everyone knows what to do?

67. Do you understand the "Gas precautions," do you observe them fully, and do you frequently practise "Gas drill"?

68. What will you do with casualties in the battery? Where is the nearest dressing station?

69. Assuming, if the enemy attacked on a large scale, that there were a severe preliminary bombardment followed by gas and a possible rapid advance, what action would you take? You would probably have all telephone lines cut and would thus have to act entirely on your own initiative. Have you means of laying and switching if your normal aiming points are obscured by smoke?

70. If you are ordered to retire, do you know the position that is reserved for you to retire to, for each line of defence that we hold? Have you visited rear O.Ps. from which our own front system of trenches can be observed in case these should be occupied by the enemy? Do you know what arrangements are made for establishing communication with these O.Ps.?

VII. LIAISON.

71. Do you make friends with the Infantry in front of you and ask them to your O.P. and battery when you are shooting? It is of the greatest importance to get the Infantry to have absolute confidence in you and your shooting.

72. Do you go and visit other batteries, including R.F.A. batteries, and O.Ps., and thereby see any improvements they may have? 3

73. Are you in close touch with the R.F.C., the Kite Balloon Section, the Topographical Section, and the nearest Field Company? All these people can help you with your work.

VIII. CAPABILITIES OF YOUR BATTERY.

74. What is your extreme range on a hot day with a 10 M.P.H. wind behind you, and on a cold day with a 30 M.P.H. wind against you?

75. What is your extreme rate of accurate fire? Do you rest your guns periodically when firing for long periods at a rapid rate? (The general rule is 10 minutes in every hour). Have you got water, for cooling the guns, handy?

76. How many guns can you get on any particular place in your arc of fire?

77. What is the shortest range at which you can fire?

78. How long does it take you to get the first round off from receiving a surprise order to fire?

79. How long would it take to get out of action if you were ordered to advance at this moment?

IX. TELEPHONY.

80. Can you buzz and read Morse fast enough to be of use?

81. Can you read and send semaphore?

82. Do you thoroughly understand the D3 telephone, particularly the three tests which show if it is in proper working order?

83. Do you test the voltage of your cells frequently?

84. Is your equipment complete, both for visual signalling and telephony?

85. Are your lines in good order? Do you test to see whether bad speaking of lines is due to bad insulation or bad joints? (See Appendix I).

86. Have you taken precautions that your linesmen are as little exposed to shell fire as possible, that is, by having test points in safe places and the route for the line laid out accordingly? You cannot expect to keep your lines "through," when heavy shell fire commences, if your linesmen have to work all the time exposed to this fire.

87. Do you know exactly the route of each line? And do you periodically walk your lines?

88. Have you several alternate routes for communication and do you take every precaution to make your lines safe by burying them at least 6 feet? Do you realise how the use of china insulators (which you can procure from signal companies) will save your air-lines from deteriorating?

89. Do you understand your telephone exchange and do you know the calls for your different stations?

90. Are your buzzer calls carefully selected, so as to avoid clash-ing with those of neighbouring units which are inter-connected with you? Do you employ four letter calls where one letter is sufficient?

91. Do you pay strict attention to the orders with regard to "using earths" within the zone of "over-hearing" by the enemy?

X. FIELD ENGINEERING.

92. You are often required to construct dug-outs and gun em-placements which are weather-proof, shell-proof, and, at the same time, proof against detection in aero photos taken by the enemy.

93. Can you construct a dug-out and a gun emplacement which is proof against a 5.9" shell? Do you understand the advantages of a "bursting course" and "double roofing?" (See Appendix II).

94. Do you make as much use as possible of cupolas?

95. When constructing a gun pit do you make certain that the roof is not higher than necessary? There is always a tendency to make the roof too high, thus adding height to the pit and making it conspicuous.

96. Do you fully realise how essential it is to have proper frame-work for your dug-outs and gun emplacements when they are first constructed? It is very difficult and unsatisfactory to reinforce the supports afterwards. Are your supports more than 18 inches apart?

97. Are you careful to give ample support to the beams or girders you use for framework? It is little use employing heavy girders if you only support them for two inches at each end.

When building up sandbags on a trench, or excavation, are you careful to leave a ledge so that when the earth crumbles away your sandbags will not collapse for want of support? Do you make the greatest use of timber so that it gives its greatest strength? Are the entrances to your dug-outs very strong, and do they face away from the direction of hostile shell-fire? Have you two entrances for each men's dug-out?

98. Before constructing dug-outs, etc., do you go to see neighbouring batteries (particularly those which have had winter experience in the area) and find out what they recommend? Have you studied the designs for gun pits issued?

99. Have you studied the drainage problem of your battery position?

100. Do you take every precaution to make the dug-outs, etc., weather-proof? Will the roof leak? Will water get into the dug-outs through the entrance? If water does get in, is there a large sump? (The ideal floor is cement, drained towards a deep sump and covered with high trench boards; or in chalk, the trench boards are sufficient, provided the floor is kept free from mud which blocks the natural drainage.)

101. Do you realise how easily battery positions can be detected on aero-photos from (i) shadows thrown by the outward form of the dug-out and emplacement, (ii) tracks leading about the battery, (iii) the blast from the guns on the ground in front of the pits. Do you take precaution against these?

102. Do you endeavour to mislead the enemy as to your position by (i) a not too-obvious dummy position two or three hundred yards away with an artificial blast in front of the guns, (ii) artificial tracks in front of your battery position?

103. Have you had an aero-photo taken of your battery position?

104. Are your telephonists' dug-out and your B.C.s' dug-out really well constructed and shell-proof, and is there ample room for the detachments in their dug-outs?

105. Are your detachment dug-outs so placed that the men can man their guns in the least possible time?

106. Have you got a good road up to the vicinity of the position along which wagons may drive for replenishment of ammunition, etc.? Wheel-tracks up to the position must be avoided; if there is not a good road these tracks are inevitable.

107. Do you make use of speaking tubes? You can get special mouth-pieces from the First Army Workshops, R.E.

XI. ROUTINE, DISCIPLINE & COMFORT.

108. At what time in the morning are your men clean and shaved? At what time is the battery position absolutely clean and tidy?
109. Do you hold frequent kit inspection to see that the men's equipment is complete and in good order?
110. Do you know how much pay each of your men gets and whether their dependents are receiving their full allotment?
111. Do all your men wear identity discs and carry field dressings?
112. Do you know who are the men to trust in your section; who are worth promoting; who are lazy; and who are slackers, and malingerers?
113. Can you trust all your N.C.Os.? Can your senior N.C.s. take your place if you are a casualty? If they cannot, are you training them?
114. Are the cooking arrangements satisfactory? Do your men get the rations cooked as they like them? Do you arrange that they can purchase any luxuries they want from the Expeditionary Force Canteens?
115. Do your men do a full day's work? Do you keep fairly short hours, but have your men working really hard at every job they do?
116. Do you appreciate that men will not work hard when they are required to do so, if they are continually permitted to slack?
117. Do you appreciate that men cannot continually do more than six-hours shifts per day, for really hard physical work or mental work such as telephone exchanges?

A normal day's work for any man should be 12 hours, of which 6 may be as above.

118. Do you see that your men get recreation in the form of football or cricket?
119. Do you appreciate how much competition improves the standard of work by giving the men a sporting interest in their work?
120. Do you frequently hold small classes in laying, telephony, etc.? Do you occasionally have gun drill with servants, cooks, telephonists, etc., taking working numbers, giving the junior N.C.Os a chance of practising the duties of No. 1?
121. Do your men do their work at the double? Is their gun-drill smart? Do they spring to attention when spoken to by an Officer?
122. Do they appreciate how much external appearance coincides with internal efficiency?
123. Do your men firmly believe that theirs is the best battery in France, and have they a right to this belief?

XII. HYGIENE.

124. Are your latrines properly situated and in good condition?
125. Is your cook-house well constructed and absolutely clean?
126. Where do you get your water from? Have you had it tested?

127. Do you take precautions that the water is boiled before being drunk, unless you know it to be certified as drinkable?
128. Can your men get a hot bath, clean shirt and drawers once a week? Also clean and dry socks as required? Is there a battery barber?

XIII. STABLE MANAGEMENT.

(For horse-drawn batteries).

129. Do you know what your horses' forage ration is and do you see that they get full weight? Do you know good oats or hay from bad oats or hay?
130. Does your battery employ a chaff-cutter or have you some means of obtaining chaff for your horses?
131. Do you attend "Stable hour" as often as possible, and, if in charge, do you see that the grooming, watering and feeding are well regulated?
132. Do you see that your horses are in good condition and comfortable—i.e., that their shelters are good and water-tight; that there are no draughts of cold air; that the standings are in good order and out of the mud and water; and that the horse-rugs and nose-bags are kept in good order?
133. Do you examine each horse at stable hour to see that he is clean, free from vermin, and, particularly, that his feet and heels are in good order?
134. Do you understand the shoeing of horses and do you see that your horses are properly shod, that spare shoes are in their proper place and that the shoeing smiths' tool-bags are properly equipped?
135. Do you know the various grains and seeds which can be used for fodder in the absence of oats, equivalent amounts and their effects?
136. Have you seen whether the entrances to your horse-lines are well metalled and dry, and that the approaches to and surroundings of water troughs are similarly treated?
137. Do you understand the symptoms and cure of simple ailments, and has your battery instructions regarding the prevention of the spread of infectious diseases, such as mange?
138. Do you know who your V.O. is and where he can be found? Do you know what the farrier's wallet contains, what the articles are for, and where the wallet can be found?
139. If horses are out late at night have you an N.C.O. detailed to see that when they come in they are properly cared for at once?
140. Do you inspect your harness frequently to see:
    . That the leather work is well-cleaned and rubbed, and especially that working parts such as breast-collars, girths, sweat-flaps, are kept soft and pliable?
    a. That the steel work is thoroughly cleaned and then rubbed lightly over with clean oil?
    b. That every article of harness fits its wearer properly, as laid down?
141. Have you got good cover for your harness? Is the cover large enough to enable the drivers to clean their harness under shelter?
142. Have you ever read a small official pamphlet called "Saddles and

Sore Backs" and one called "Animal Management"?

143. Do you ever inspect the drivers' "horse-kits," and do you know what each should contain?

144. Do you inspect the battery vehicles frequently, especially the G.S. wagons, to see that nothing is wrong with them? "A stitch in time saves nine."

145. If on the move and a horse goes so sick that it has to be left behind, do you know with whom you should leave it, and all the regulations regarding such an eventuality?

146. How often are your horses fed? "Little and often" should be your policy. Never less than four feeds a day, and preferably five: first feed as early as possible, and the last (and biggest) as late as possible.

147. Do you appreciate that in cold weather a rug is as good as an extra 2 lbs. of oats?

148. Do you know the regulations re: clipping? Clip trace high and no higher; do not clip legs. No fancy clipping. Keep manes hogged close. Amendment to G.R.O., 1238, states:—"At the first, clipping horses may be clipped all over except the legs."

149. Do you realise how much a horse's condition depends on good water, and plenty of it? Always water from troughs if possible.

150. Do your men really work hard when grooming? Short stable hours, and hard work while at it, should be the rule.

151. Remember that the essence of horse mastership is the "master's eye."

XIV. MARCH DISCIPLINE.

152. Do you realise that good discipline, or the reverse, shows up more on the march than at any other time?

153. Do you and your drivers dismount as a matter of course when halted? Do you realise the importance of getting the weight off the horse's back on every possible opportunity? All mounted men, officers included, should walk and lead at intervals.

154. Do you see that your men never slouch in the saddle?

155. When on the march do you supervise your command and not always ride at the head? See that your Nos. 1 do the same; you should see that the horses are being properly kept up in draught, harness properly fitted (this often only becomes apparent when on the move), carriages not overloaded, and the proper balance of the pole maintained; this cannot be done if men are allowed to ride on the trail or perch.

156. Do you see that your horses are watered and fed whenever possible on the march, and that girths are slackened?

157. Do you realise that a horse cannot drink his fill or even drink comfortably with a man sitting on his back? Or with the bit in his mouth?

158. Do you drop heavily on any cases of ill-treatment of horses?

APPENDIX I. TESTING TELEPHONE LINES

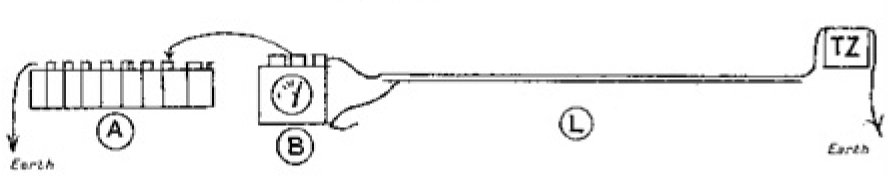
When a telephone line is first laid, the speaking is generally very good. This gradually deteriorates until the line becomes useless. The deterioration can be prevented if it is checked the moment it commences; but this pre-supposes that the cause is known and can be isolated. The tests explained hereunder are to isolate the cause.

The causes of deterioration are, firstly, increase in resistance of line due to rusty joints, etc.; secondly, increase in leakage due to insulation wearing off, etc.

The results of the tests below should be carried out daily and entered in a book so that the linesmen can check any tendency to deterioration.

I. TEST FOR COMPARATIVE RESISTANCE OF LINE

DIAGRAM I



"A" is a battery of 10 dry cells.

"B" is a Q and L linesman's detector (part of battery equipment).

"TZ" is the telephone at "Z" station.

"L" is the line to be tested.

The operator warns "Z" that he is going to test, and then disconnects the line from his 'phone and connects it to the detector. The other line from the detector is connected to the cells in series, increasing the voltage by one cell at a time until a half way deflection is obtained on the detector. The number of cells and the deflection are written down.

If, on subsequent tests, this deflection becomes decreased or more cells are required, the line resistance is increasing. A linesman must then thoroughly overhaul the line, having it tested frequently until the deflection increases to the old amount. The earth-pins should be tested and watered to see if this is the cause of the increased resistance.

II. TO TEST FOR LEAKAGE

The connections are very similar to the previous test except that all 10 cells must be connected up to the detector. Instead of leaving the 'phone connected up at "Z," it is disconnected and the bare end kept away from contact with anything. If there is no leakage there will be no deflection of the needle. Whatever de-flection is obtained is a comparative figure for leakage. If this increases the insulation of the line must be overhauled.

Both tests are equally important.

If the above explanation is not understood, get hold of a signal officer who will explain it to you.

APPENDIX III. SHELL PROOF COVER.

Practically no cover which can be constructed in a battery position is proof against the penetration of a heavy shell.

It is therefore necessary to cause it to burst before it has penetrated, and, if possible, to deflect it so that it will not tend to penetrate actually into the pit.

In constructing overhead cover a definite scheme must be kept to.

The following is one example of many, and illustrates the general principle.

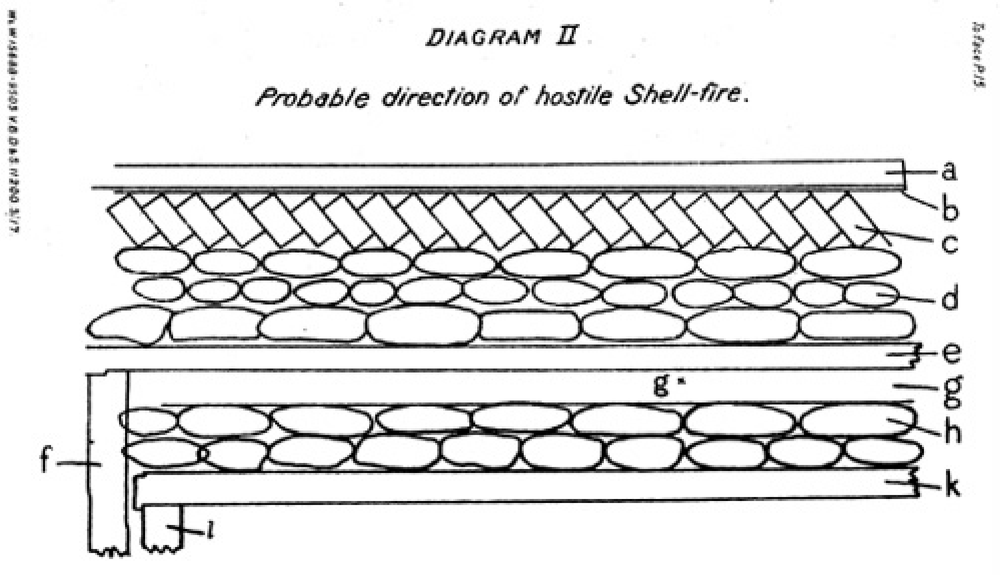


DIAGRAM II

Probable direction of hostile Shell-fire.

The protection consists essentially of the following parts, from the top :

159. A hard flat "bursting course," which retards a howitzer shell sufficiently to cause the fuze to act very quickly and in the case of a gun shell, with a small angle of descent, may deflect it altogether.
160. A "deflecting course" which turns the shell that has already penetrated the bursting course, into a more horizontal direction.

161. A "cushion" in which the shell should explode. It is soft so that the shock may be disseminated.
162. A supporting framework with splinter proof cover. In ideal conditions each part should be supported separately, with a small air space in between each, so that the shock on each part is borne separately. Practically, 1, 2 and 3 should be sup-ported separately from 4.

Considering the roof in detail:

ggggggg. is a concrete roof about 5" thick, reinforced with expanded metal. This is the "bursting course." Immediately under it is a roof of match-boarding or corrugated iron (b) which held the concrete in position until it had set. If the concrete roof was made thick it might enclose the explosion and collapse the whole cover.
hhhhhhh. is a layer of bricks laid on each other so as to form a deflecting course.
iiiiiii. is the "cushion" in which the shell is to burst, made of sandbags full of gravel or slag,
jjjjjjj. is a supporting roof of girders, iron rails or baulks, kept up by the stanchions (f). This must be covered by boarding or corrugated iron to prevent the sandbags escaping.
kkkkkkk. is a small air-space which allows a certain amount of sagging of the upper supporting roof before any pressure is borne on the lower supports.
lllllll. is a splinter-proof cushion course laid on the lower supporting roof.
mmmmmmm. is the lower supporting roof, rather stronger than (e) as it may have to bear the weight of both roofs. It is supported by stanchions (f). It would be improved by a 6-inch layer of concrete immediately above the supports which would distribute a force on any point over the whole lower roof.

APPENDIX IV. PUBLICATIONS.

Have you got copies of the following? Have you read and understood them?

Range, table, handbook and gun-drill for your particular weapon.
Garrison Artillery Training, Vol. II., or *Field Artillery Training.* (According to whether you are in a Siege or Heavy Battery).
Notes on Ammunition for 4.7" and 60-pdr. guns (applies equally to almost all heavy shell).
Defensive measures against gas attacks (S.S. 534).
Ranging on the line of observation. (40/W.O./2778).
Chart for computing angle of sight (1st Printing Co. R.E., G.H.Q., 2171), or some similar device.
Notes for Artillery Officers on shoots with Aeroplane Observation S.S. (350).
Some notes on meteorological conditions which affect Gunnery (S.S.418).
Silhouettes of Aeroplanes (S.S. 350).
Card of Signals between Aeroplanes and Artillery (40/W.O./3249.
Co-operation of Aircraft with Artillery (S.S. 131).
Training Manual. Signalling. Part I.
Notes on cover against shell fire (S.S. 116).
Artillery Dial Range Corrector (for working with R.F.C.), or similar device.

25: Artillery Instructions for the battle of Cambrai, October-November 1917

Source: Reprinted in OH 1917, vol. 3, appendices 6A-6C, pp. 322-339.

Third Army Artillery Instructions No. 18

1. Essential features of the Operation.

The essence of the operation is surprise. Every possible measure must therefore be taken to conceal the preparation of positions and accumulation of ammunition. The amount of fire on the front prior to "Z" Day will be absolutely restricted to the normal daily average of the past three months.

No firing by natures heavier than those that have been continually in position on this front will be permitted. It follows that camouflage, preparation of battery boards, and calibration of guns, assume great importance.

2. Camouflage.

The erection of camouflage to hide work and tracks must be taken in hand forthwith before any other work. Requirements in material should be notified to Corps camouflage officers with the least possible delay. Officers and N.C.Os. should be sent to the Corps Camouflage depots to inspect the various types of camouflage available and to receive instruction in their proper erection. Movement where and when detection by the enemy is possible must be reduced to an absolute minimum.

3. Battery Boards.

Battery positions must be selected and the sites marked with pegs so that the preparation of battery boards may be put in hand without delay.

The positions marked should include not only those for occupation at the commencement of the operation but also those positions close to our present front line, to which it is intended to move batteries during the progress of operations.

It is essential that batteries should occupy the exact sites which have been selected and surveyed, if this is not done the utility of the boards is almost entirely lost.

4. Calibration of Guns and Grouping according to Wear.

As much calibration of guns and howitzers as is possible without increasing the volume of Artillery fire should be carried in the line, with the aid of the Observation Groups and Sound Ranging Sections. Units moving to III. and IV. Corps from other Corps within Third Army must have the calibration of their pieces checked before moving.

In addition calibration will be carried out by III. Corps on their range near Quinconce, and the Army range at Fricourt will be placed at disposal of IV. Corps for this purpose.

Assistance will also be given to III. Corps on the Army range if required. Arrangements regarding the use of the Army range will be made with H.Q., R.A., Third Army.

Guns and howitzers should be grouped in batteries according to wear and loss of M.V., as determined by examinations by I's.O.M. [Inspectors of Ordnance Material] and the result of calibration shoots.

5. Considerations affecting selection and preparation of position.

The scheme is based upon the attainment of a rapid break through without a pause.

The artillery must therefore be disposed to cover the whole operation of penetrating the hostile trench system with the minimum of forward movement.

This necessitates the most forward possible positions being selected for all natures especially 60-pdrs. As no fire will take place from these positions before Zero hour the danger of disclosure to the enemy will be considerably reduced.

The protection of the flanks of the attack from counter-attack will be of great importance; as the attack proceeds it will be necessary therefore to push forward field batteries rapidly positions from which an enfilade protective barrage can be established.

The Heavy and Siege Artillery must be placed sufficiently far forward to deal at Zero hour with the whole of the known hostile gun positions bearing on the front of attack.

Weather-proof shelter for ammunition and personnel and slit trenches for the protection of personnel is probably all the work that will be possible to complete in the time at disposal.

In the case of R.H.A. batteries temporarily allotted to III. and IV. Corps, special consideration must be given to facilities for rapid advance. For this reason these batteries should not be placed too far forward in the preliminary arrangement of the Artillery at disposal.

Camouflage and cover for ammunition must be prepared at such forward positions as it is proposed to occupy during earlier moves of batteries. Dumps of ammunition will have to be formed at such positions in anticipation of occupation.

The most completely sound-proof protection possible must be provided for wireless operators and battery command posts.

The positions of Brigade and Group Headquarters must be selected early and not changed or the provision of the necessary telephonic communication is rendered very difficult.

The selection of battery positions must not be arbitrarily fixed by Corps boundaries. If Corps are unable to adjust their requirements mutually the matter should be referred for Army decision. The requirements of the Tank Corps must be considered. A representative of the Tank Corps will be attached to III. and IV. Corps H.Q. and this officer should be kept informed of the proposals for placing the Artillery.

6. Communications and O.Ps.

The selection and allotment of suitable and sufficient O.Ps. for reinforcing batteries will require immediate attention.

Likely positions for O.Ps. beyond the hostile front trenches must be selected from the map as it will be necessary to push forward Artillery observers very rapidly.

The question of the augmentation and improvement of telephonic communications should be considered with A.D. Signals of Corps. Points to be attended to were dealt with in Third Army letter No. R.A. 2510 of 4.10.17 addressed to G.O's.C.R.A., Corps.

Owing to shortage of time and labour it will be absolutely necessary to concentrate on those circuits which are essential for the operation. For the same reasons and for the sake of secrecy no new trenches for burying cable will be constructed.

Very careful consideration must be given however to ensure previously prepared air lines, or cables laid above ground are not destroyed during the artillery concentration.

Mobile cable equipment of units must be complete.

Arrangements for visual signalling communication, probably with the Lucas lamp, must be considered and the necessary practice of signallers carried out.

7. Various tables attached.

Table "A" shows a proposed distribution of Artillery resources on the Army front at Zero hour.

Table "B" shows the allotment of Artillery units to III. and IV. Corps in detail and the sources from which they will be drawn.

Table "C" shows the units to be detailed by VI., VII. and XVII Corps for transfer to III. and IV. Corps. In certain cases there is no latitude for selection by Corps and in such cases the designation of units to be transferred is shown in Table "B." VI., VII. and XVII. Corps will report to Army H.Q., and repeat to Corps concerned, the designation of other units to be transferred so that Table "B" may be completed.

Table "D" shows the number of guns available in III. and IV. Corps for the operation.

Table "E" shows proposed dumps of ammunition.

8. Trench Mortars.

No special allotment of Trench Mortars has been made.

The fullest possible use will be made of all natures of mortars to bombard the hostile trenches on the immediate flanks of the attack.

Any requirements in pieces which Corps cannot meet from their present allotment should be notified to Army H.Q. without delay.

Corps will also notify Army H.Q. as soon as possible of their requirements in Trench Mortar ammunition.

9. Outline of Artillery action.

The Siege and Heavy Artillery will be employed in neutralization of hostile batteries, bombardment of O.Ps., positions of assembly, main routes of movement and of telephonic communication, rest billets, command posts. Particular attention will be paid to villages and approaches on the flanks, where troops might assemble and debouch to counter-attack.

Smoke barrages will be required from Zero hour on the following areas:—

a. The high ground in M.27, M.32, M.33 (sheet 57b) [Spur S.E. of Bantouzelle].
b. On Spur R.28.d., R.29.c. [Spur E. of Gonnelieu], if this is not included in the attack.
c. On known O.Ps. not at the time covered by the barrage.
d. On the main Hindenburg Line L.32c. to the S.E. [Couillet Wood area].
e. On the Havrincourt—Flesquieres Spur.

The barrage covering the movement of the Tanks and Infantry will not be a creeping barrage but will lift from one Trench line to the next, or from objective to objective, as the case may be.

This barrage will consist of 13-pdr. and 18-pdr. firing Shrapnel, such 4.5" Howrs., firing H.E. instantaneous fuze as are not required for smoke barrages, and any 6" Howrs. that can be spared from counter-battery or bombardment also firing instantaneous fuzes.

The 6" Howr. barrage should concentrate on known O.Ps, machine gun emplacements and should not be placed nearer than 500 yards to the line of advancing Tanks. It will be of special importance to deal at once by a heavy concentration with mobile anti-tank guns, or any guns moving into action in the open for the engagement of the Tanks or the infantry.

Certain Field and Heavy Batteries must be specially told off to engage immediately any counter-attacks, or bodies of hostile troops, reported by aeroplane or Kite Balloon Observes, or from terrestrial O.Ps.

10. Miscellaneous points.

Attention is directed to the following points which will require consideration:—

a. Certain 6" Howr. batteries should be provided with teams from 60-pdr. batteries, to enable a proportion of 6" Howrs. to be advanced rapidly.

b. It is a help to have parties of R.E. and infantry told off to assist batteries who are required to move forward early and rapidly, in the construction of ramps and bridges.

Drills should be carried out with any parties it is possible to detail. The tools normally carried on battery vehicles are insufficient and should be supplemented by a special issue to batteries detailed to move early.

c. R.A. officers who know the front well should be specially detailed to go round O.Ps. and point out the country to reinforcing Artillery. This is of particular importance in the case of incoming Heavy and Siege Artillery.

d. The distribution of the battery personnel into proper reliefs. An unnecessary number of men at the gun position increases casualties with no corresponding increase in efficiency. Although the scheme of operations does not contemplate prolonged Artillery action, the exact duration cannot possibly be foreseen and a proper reserve of resting personnel for relief of detachment is essential.

e. It is hoped to establish a forward Meteor office in each Corps area.

f. Experience has shown that the control of several R.F.A. Brigades by one R.F.A. Brigade H.Q. as a group is an unsatisfactory arrangement if it can possibly be avoided.

11. Map showing distribution of Artillery.

A map showing distribution of Artillery (Brigades F.A. and H.A., batteries Heavy and Siege, and Group and Brigade H.Q.) will be forwarded to H.Q., R.A., Third Army as soon as possible.

Louis Vaughn,
Major-General,
General Staff, Third Army
29.10.17 [as amended 5th and 11th November 1917]

12. Artillery fire before Zero hour.

No firing whatever will be carried out from any newly occupied position before Zero hour.

13. Allotment of Field Howitzer Batteries to Cavalry Corps.

Each of III. and IV. Corps will detail one 4.5" Howitzer Battery to be attached to the Cavalry Corps as soon as the leading Cavalry Divisions advance from the line Gouzeaucourt—Metz en Couture. The batteries will each consist of 4 Guns and 8 wagons with 8-horse teams throughout.

50 per cent, of the ammunition in the echelons will be fuzed 106 fuze. III. and IV. Corps will inform Cavalry Corps designations of units selected and positions in action.

Cavalry Corps will arrange with III. and IV. Corps when and where these batteries will actually join the Cavalry Divisions on the march.

14. Reversion of R.H.A. Batteries to Cavalry Corps control.

R.H.A. Batteries of 2nd, 4th and 3rd Cavalry Divisions, allotted to III. and IV. Corps respectively in the preliminary distribution given in table "B" dated 5.11.17 attached to Army Artillery Instructions No. 18, will again be at the disposal of the Cavalry Corps as soon as the leading Cavalry Divisions advance from the line Gouzeaucourt—Metz en Couture.

The III. and IV. Corps will not move these batteries from the position in which they commence the action without reference to the Cavalry Corps.

15. Artillery Liaison Officers with Infantry formations, etc.

A Field Artillery Liaison Officer will be detailed to accompany each Infantry Brigade Headquarters participating in the attack.

He must be aware of all the Artillery dispositions which may affect the Infantry unit to which he is attached.

A Senior Heavy Artillery Officer (Group or Battery Commander) will also be detailed to accompany Divisional Headquarters. This officer will act as a Liaison Officer from the Corps Heavy Artillery and will be prepared to offer suggestions as to suitable objectives for engagement by the Siege and Heavy Artillery, and will also give any information required by Divisional Headquarters as to the number and nature of Heavy Guns and Siege Howitzers that can be expected to be able to fire on any objective which it is desired to engage.

Corps will detail such other Artillery officers as are deemed necessary for the special mission of watching the progress of the Infantry and keeping Artillery Commanders informed of the tactical situation.

Artillery Liaison Officers must join the formation to which they are attached at least 24 hours before Zero.

It must be remembered that the ability to concentrate Artillery fire rapidly on troops massing for counter-attack, or on hostile batteries which are checking the advance of the Tanks and Infantry, will be essential to success.

16. Allotment of an additional 4.5" Howr. Battery to III. Corps from IV. Corps.

IV. Corps will place one 4.5" Howr. Battery at disposal of III. Corps for the special purpose of assisting in the formation of a smoke barrage about Premy Chapel.

This battery may be the battery detailed to accompany the Cavalry according to Section 2.

17. Rates of Fire.

For continuous bombardment, unless otherwise ordered (including "protective" barrages).

18-pdrs. or 4.5" Howrs.: 3 rounds per battery per minute or 1 round per gun per 2 minutes.
6" Howrs.: 1 round per battery per 3/4 minute or 1 round per howitzer per 3 minutes.
8" or 9.2" Howrs.: 1 round per battery per 1_ minutes or 1 round per howitzer per 5 minutes.

For counter-battery work.

The rate of fire must be decided according to the circumstances of each case.

For super-heavy Howitzers and Medium and Heavy Guns.

The rate of fire must be decided according to the circumstances of each case.

For barrage fire (including "creeping" and "standing" barrages but not "protective" barrages).

18-pdr.: 2 rounds per gun per minute up to 4 rounds per gun per minute, but latter

rate is not to be maintained for more than 10 minutes.
4.5" Howr.: 1 round per gun per minute.
6" Howr.: 1 round per gun per 2 minutes.

18. Records of Tasks.

Battery Commanders and F.O.O's. must have a record of the tasks to be carried out by their battery, together with all necessary orders, in a notebook on their person.

19. Anti-aircraft Arrangements.

The attached map shows the scheme of anti-aircraft defence at Zero hour. The first moves proposed are also shown, these will take place by Decauville Railway.

No anti-aircraft lorries will cross our present front line without orders from H.Q., R.A., Third Army, and such orders will not given until it is clear that the condition of the roads is satisfactory.

20. Table of Moves, etc.

A Table of moves must be drawn up for all Artillery units until the line Masnieres—Marcoing—Premy Chapel—Flesquieres been captured. This table must show designations of units, lines of advance, tasks, probable O.P.'s and approximate position to be occupied.

The preparation of routes across the wire must be put in hand at the earliest possible moment. The arrangements for bringing up the gun teams and ammunition wagons of batteries detailed to move must be carefully worked out in order to avoid delay.

Officers frequently find difficulty in fixing their own battery positions on the map after advancing across the hostile trenches, this must be considered and suitable points from which to resect decided upon beforehand. In determination of the position from detail on the map, the 1/10,000 scale map will give much more accurate results than the 1/20,000.

21. Maintenance of Dumps and clearance of positions after the attack, etc.

a. "Dumps" will be maintained after Zero hour at the following figures per piece : —

	In Corps	
	At Guns	*Reserve*
18-pdr.	100	100
4.5" Howr	100	50
60-pdr.	100	50
6" Howr.	100	50

6" Gun	100	50
8" Howr.	75	25
9.2" Howr.	75	25
12" Howr.	50	-
15" Howr.	-	-

b.

c. In the event of the operation being completely successful the Army will be responsible for issuing orders regarding the clearance of any ammunition left behind in vacated battery positions. If however the operations are only partially successful Corps must make every endeavour to utilize ammunition left at vacated battery positions to avoid pressure on the main lines of railway.

d. In addition to Corps Reserve and Gun Dumps it hoped to hold the following stock of ammunition at Army Railheads for III. and IV. Corps at Zero hour.

18-pdr.	100 rounds per gun
4.5" Howr.	100 "
60-pdr.	100 "
6" Howr.	100 "
6" Gun	100 "
8" Howr.	100 "
9.2" Howr.	100 "
12" Howr.	50 "

22. Collection of information regarding the Hostile Artillery. Great reliance is now placed on the Observation Groups and Sound Ranging Sections of the Field Survey Company for the collection of information regarding the hostile Artillery.

After a successful attack some time must elapse before these organizations can be re-established and during this period it is most important that Artillery Observation officers should realize that the responsibility for locating the positions of the hostile batteries devolves very largely upon them.

23. Co-operation with R.F.C.

Corps Squadrons will require a programme of the neutralizing fire it is proposed to carry out so that fire may if necessary be corrected.

Beyond this the R.F.C. work will consist of reporting hostile batteries that are active and observing and correcting our fire upon them, and in calling for fire on concentrations of hostile troops.

Slow and deliberately observed counter-battery shoots for destructive effect will not be attempted.

A Kite Balloon will ascend at as close a range as possible in each Corps area. These Balloons must be especially used for reporting and engaging hostile troops concentrating or in movement. Speed and a heavy concentration of fire will be important and direct telephonic connection to a selected Heavy Artillery Group will probably be the best arrangement.

24. Action after the 1st stage is completed.

- a. A Heavy Artillery Group consisting of one 60-pdr. battery and one 6" Howitzer Battery under a Group Headquarters should be allotted to each of the leading Divisions. Arrangements should be made within Corps to provide the 6" Howitzer Battery detailed with horse draught from one of the Heavy Batteries.
- b. On Z + 1 day it will probably be necessary for the 40th Divisional Artillery to rejoin its division with the V. Corps.
- c. On Z/Z + 1 night at least two 12" Howitzers (Railway Mounting) from Velu [5 m. W. of Havrincourt] and possibly also one 9.2" Gun (Railway Mounting) will be moved round to Vaulx Vraucourt [8 m. N.W. of Havrincourt].
- d. On Z + 1 day the VI. Corps will probably be called upon to assist IV. Corps by the bombardment of Queant and Pronville [1 m. S.E. of Queant].
- e. The following points are drawn attention to, being lessons drawn from the advance in the Bapaume area during March 1917.
  - i. Until the roads have been thoroughly repaired, it is not advisable to push forward many heavy Siege Howitzers and Heavy Guns. Even if the pieces themselves are got forward it is impossible to maintain the ammunition supply. On the other hand a single 9.2" or 8" Howr. and a single 6" Gun will prove invaluable, and a fair chance exists of maintaining a sufficient supply of ammunition for a small number of pieces. One Heavy Howitzer will frequently be the quickest, and will always be the least expensive way of expelling the enemy from a village or hastily prepared strong point which cannot be passed by.
  - ii. Battery Commanders having become accustomed to very detailed orders and instructions and to the stagnation of trench warfare do not realize the necessity for resolute initiative and speedy action. The drill of batteries too is slow. All ranks must realize that speed and vigour are essential to attain complete success.
  - iii. The necessity of appointing a Commander of the artillery of any detached force is not always realized. If this is not done any attached Heavy Artillery are sometimes left without orders. This Commander must be given an adequate staff and suitable communication facilities. 60-pdrs. and 6" Howrs. should always form part of an advanced guard of any size.

iv. As soon as a check occurs and an organized Artillery action becomes necessary it is essential for the Corps to resume close tactical control without delay. The Corps Heavy Artillery Commander and his Staff must keep in close personal touch with the progress of mobile operations so as to be in a position to take over immediate tactical control of the Heavy Artillery.

Louis Vaughan,
Major-General,
General Staff, Third Army.
10.11.17.

Third Army Artillery Instructions No. 20

The action of the Artillery on the day of attack will be based on the following instructions:—

25. All Guns, Howitzers, and Trench Mortars in III. and IV. Corps will open fire on their respective tasks at Zero hour.

Before Zero hour the normal night firing programme will be carried out. It is necessary that there should be no increase of fire, and it is almost equally important that the night should not be abnormally quiet.

At Zero hour the leading echelon of Tanks will cross a line approximately parallel to the First Artillery barrage line and about 800 yards away from it. The exact distance will vary according to the nature and slope of the ground and will be adjusted within Corps.

26. 442nd Siege Battery (9.2" Gun Rly. Mtg.)

Both Guns: Target (a) Sailly [map co-ordinates given]. Resting battalion. 25 rounds a gun. 50 rounds in all.
One Gun: Target (b) Haynecourt [map co-ordinates given]. Resting battalion. 50 rounds.
One Gun: Target (c) Billets in the barracks at A.17.a.65.45. [in Cambrai] 50 rounds.

At all above places resting battalions are billeted. Target (a) will be engaged by both guns at the same time, and will be engaged first. Fire will be opened at Zero hour by both Guns.

Further tasks may subsequently be ordered by the Army according to the progress of operations, but, in the event of no further tasks being ordered, Corps will be at liberty to issue orders to these guns direct, informing H.Q., R.A., Third Army of the action taken.

Corps will be responsible for arranging aeroplane observation for ranging on the targets allotted, if such observation is possible, but it is to be clearly understood that the carrying out of the programme is not to be delayed or abandoned on account of inability to obtain aeroplane observation.

27. The following objective should be engaged by the long range guns and long range howitzers of Corps at Zero hour.

III. Corps

a. Les Rues des Vignes apparently much used as a billet. Special attention should be paid to the neighbourhood of the locks and bridges. Resting battalion here [map co-ordinates given].
b. Crevecoeur the buildings about [map co-ordinates given] appear to be of the most importance. Resting battalion here.
c. Masnieres with special attention to the Station and the buildings about [map co-ordinates given]. Care to be taken to safeguard the bridge on the Bonavis—Masnieres Road. 106 Fuze to be used by Howitzers. Resting battalion here.
d. Rumilly. Southern half of the town seems to be of the greater importance. Resting battalion here.
e. Marcoing and Marcoing Station. It is most important not to damage the road bridge and lock and also the railway bridge. 106 Fuze to be used by Howitzers. Regimental H.Q. and Resting battalion at [map co-ordinates given].

IV. Corps

f. Noyelles Sur L'Escaut. Battalion H.Q. and Resting Battalion [map co-ordinates given].
g. Cantaing Billets. Resting Battalion [map co-ordinates given].
h. Nine Wood. Dug-outs in Quarry L.16.a.5.4. [S.W. of wood].
i. Fontaine Notre Dame. Regimental H.Q. Probable billets [map co-ordinates given].
j. Bourlon Billets [map co-ordinates given].

Fire will be maintained on Marcoing and Masnieres throughout the operation until the approach of the Infantry or Tanks renders it necessary to lift or switch fire from these objectives.

In other cases fire will be readjusted by Corps according to the tactical information in their possession.

28. At Zero hour as heavy a concentration as possible will be opened by all Siege Howitzers, less those required for barrage or for bombardment of the trenches on the flanks of the attack on all known or suspected billets, H.Qs., communication centres, O.Ps., and command posts. At this stage the 60-pdr. batteries

will open neutralizing fire on hostile battery positions known to be occupied, with Lachrymatory shell. This distribution of fire will subsequently be adjusted by Corps according to the activity and effect of hostile Artillery. The fire of the 60-pdr. batteries, using shrapnel, will gradually be turned on to the probable lines of approach and positions of assembly of the hostile infantry and the task of neutralization will then fall more to the Siege Howitzers.

29. Attention is directed to the importance of maintaining the following areas under fire until, in certain cases, the approach of our own troops renders this unsafe.

III. Corps

Banteux, and Bantouzelle, Pont la Grenouillere [where St. Quentin road crosses canal], Vaucelles, and the bridge and locks in M.15.c. [at Vaucelles]. These places must be kept under fire with Siege Howitzers, using the authorized proportion of instantaneous fuzes, until right flank of the attack to Lateau Wood and thence towards Masnieres is securely established.

IV. Corps

Havrincourt and Flesquieres

These places must be maintained under a heavy fire from Siege Howitzers, using the authorized proportion of instantaneous fuzes, until the proximity of our own troops renders it unsafe to continue.

30. In addition, it will be necessary to bombard heavily the hostile front system of trenches for at least 500 yards on the immediate flanks of the attack. For this purpose Trench Mortars must be utilized to the utmost extent possible in order to release all possible Siege Howitzers for tasks at longer ranges.

31. As regards other points not specially mentioned in para. 5, Corps will be responsible for arranging the bombardment within their own allotted areas as shown on the accompanying map.

32. At Zero hour the Artillery barrage, including special standing barrages of smoke, will be opened as shown on the accompanying map, and according to the following instructions: —

   a. The rates of fire laid down for "Creeping" and "Standing" barrages, in Third Army Artillery Instructions No. 19, Section 6, will be adhered to during those periods in which the Tanks and Infantry are actually progressing between their various objective lines.

   During periods of consolidation the rate of fire should be reduced to the bombardment rates laid down in the same section.

   It may, however, be necessary to increase this rate on certain known machine gun localities or strong points, or for the formation of special smoke screens. This must be decided by Corps according to the circumstances of each case, or according to reports received at the time.

b. At Zero hour, and subsequently at Z+ 150 minutes, all Artillery employed on the frontal barrage will fire a salvo of one round smoke shell. Natures not provided with smoke shell will use shrapnel, or H.E. if also unprovided with shrapnel.

In the event of the order "fire no smoke" (see sub-para. (d) below) being issued, the salvo at Zero hour will, as far as possible, consist of shrapnel. Under the same circumstances (i.e., no Smoke in frontal barrage) all 13-pdrs., 18-pdrs. and 4.5" Howrs. employed in the frontal barrage will fire from +150 to +153 at the rate of 3 rounds per gun per minute, Shrapnel to be used by 13-pdrs., 106 Fuzes by 4.5" Howrs.

c. The ammunition fired in the 13-pdr. and 18-pdr. frontal barrage will be 1/3 Shrapnel (long corrector 50 per cent. graze), 1/3 H.E. and 1/3 Smoke. H.E. with delay fuzes will be expended at the shorter ranges; at ranges over 3,500 yards on level ground non-delay fuzes must be used. If firing against a slope, H.E. with delay fuze will not ricochet at shorter ranges even than this, and non-delay fuzes should then be used.

d. The amount of smoke to be fired is calculated on the assumption that the conditions are most favourable (i.e., wind S.W. 10 to 15 m.p.h.).

A wire will be despatched from Army Headquarters to Corps at 12 midnight Y/Z in the following form: — "Fire full ration," "fire half ration," "fire no Smoke," etc., this will indicate that the amount of Smoke to be fired in the frontal barrages should be reduced accordingly.

The wire from Army Headquarters will be based on a forecast of probable weather conditions.

When conditions are uncertain, and when variable weather, visibility, and wind currents are likely in small areas, the conditions most unfavourable to the use of smoke will be assumed to be universal and to be most probable and the Army order will refer to such conditions.

It will be permissible for Corps to increase the proportion of Smoke beyond that ordered, up to the full ration only according to the local conditions, and as these conditions change during the course of the operation.

Corps may delegate this authority to Divisions if considered desirable. Under certain conditions it may also be desirable to order no smoke to be fired on any barrages West or South of the Blue line, while East or North of this line a certain proportion will be fired, and Corps must be prepared for such order. As regards the standing smoke barrages Corps will be responsible for issuing instructions as to the rate and duration of the fire according to the meteorological conditions at the moment.

Attention is directed to Third Army "Notes on Smoke Barrages" as regards placing of the M.P.I., and rate of fire required for the formation of Smoke screens.

e. The M.P.I, of the whole barrage will be kept on the barrage line. That is to say the point of ricochet and not the point of burst of 18-pdr. H.E. (delay fuze) will be on the barrage line, and smoke shell in this case will also be placed on, and not short of, the line to be barraged. This is necessary in order to reduce to a minimum the danger of a direct hit on a tank from short rounds.

f. All 13-pdr. and 18-pdr. Guns will be employed in the frontal barrage preceding the Tanks and Infantry save certain 18-pdr. batteries in IV. Corps necessarily employed in the formation of a flank barrage.

Such 4.5" Howitzers as are not required for formation of Smoke barrages or other special tasks will join in the frontal barrage. In addition any 6" Howitzers not required for the tasks specified in Sections 3, 4 and 5, will also join in the frontal barrage but not fire within 500 yards of the projected leading line of Tanks.

Howitzers will use the largest possible proportion of 106 Fuze, and their fire will be concentrated on particularly important machine gun nests, O.Ps. and communication trenches.

33. Care will be necessary to ensure that the advance of the Cavalry is not delayed or hampered by tardiness in lifting or switching fire from points in their line of advance.

34. A special Artillery weather wire will be sent out from Army Headquarters at Zero—2 hours. During Z-day Artillery weather wires will be sent out from Army Headquarters at 2-hour intervals.

Louis Vaughan,
Major-General,
General Staff, Third Army
14.11.17.
[as amended 15 and 18 November 1917]

26: Lessons from the 1917 Battle Fighting of the Fifth Army from an Artillery Point of View, December 1917

Source: Uniacke Papers, File VII/2

Frederick the Great in speaking of Officers who relied solely on their own practical experience remarked that there were in the Army two commissariat mules which had served through twenty campaigns, "but," he added significantly, "they are mules still." Practical experience unless it forms a basis for reflection and is amplified by comparison with the experience's of others loses half its value.

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APPENDICES
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(A) Tactical Notes.

1. This year's fighting has been noteworthy for a number of tactical changes on the part of the enemy.

   The measure of our success has generally depended on the extent we have been able to keep abreast of these changes, which have all been defensive on the part of the enemy and designed to minimise the power of our Artillery. Our part has therefore been to introduce such modifications and, if necessary, changes into our methods that the enemy may still feel the full weight of our Artillery in every action.

2. Artillery nowadays is probably the most important arm from the tactical point of view and is the only arm which can utilize and bring into action at the same time the whole of its strength which is accumulated in any given area.

   The principal lesson of the year's fighting is that neglect in making proper use of the Artillery, weak points in its organisation, or indecision in its tactical handling is paid for time and again by unnecessary and avoidable casualties to the Infantry and failure in the opportunities.

   All possible resources in men and material must be made use of to keep the Artillery, and the services working in connection with it, in first class order. Without this there is little hope of victory.

3. The chief tactical difficulty has been to discover changes in the enemy's dispositions and intentions in sufficient time. Often it was necessary to fight a battle to find them out.
4. Much can be done by the R.A. and Intelligence staffs working in the closest co-operation—firstly by finding out from prisoners, captured documents, etc. what the enemy's dispositions really are and secondly by a reliable forecast of what the situation is likely to be at the next battle—bearing in mind that it is often better that the Artillery should search for the *troops* of the defence rather than the *material obstacles.*

   The Artillery arrangements can then be made; but it must be realised under certain circumstances, that if the enemy is to feel the *full weight of the Artillery,* some risk that he may escape it must be accepted, as fire cannot be organised in great depth and at the same time give full results *with certainty*

   The measure of the risk depends solely on the accuracy of our previous deductions—an intelligent appreciation of the existing situation reduces this risk to a minimum. The main difficulty lies not so much in *gathering* the necessary information on which to base the Artillery plan but in the *turning to profitable account* of that information.

5. Bombardments this year have been concentrated at all points within the range of the guns according to the enemy's habits at the moment—sometimes as far back as possible, sometimes only for the first 1,000 yards—both with good results.

6. The organisation of the attack barrage also, both as regards its depth and as to the number of counter-battery weapons included in it, has undergone various changes, and must always so change in order to meet the situation in existence at the moment.

Pedantic rigidity of method in this matter should be strongly guarded against.

Certain changes and modifications, even though they may not have been forced on us by the enemy's tactics, are always advisable—they serve in a greater or less degree to help towards carrying out Stonewall Jackson's advice "Always to mystify, mislead and surprise the enemy"—advice which perhaps is often not taken sufficient advantage of by us.

The most unyielding opponents of any suggested changes in barrage methods are to be found amongst Divisional Staffs—to a counsel of their fears, being that the Infantry have been trained behind the line to expect a certain definite form of barrage which they are to follow and any change in the form of that barrage when the actual attack takes place might through [sic for throw] the machine out of gear. This giving-way to unbridled timidity on the part of those *who are not actually going to follow the barrage themselves* is much to be deprecated. It is open to the gravest doubt as to whether the men actually going over the top have the slightest idea as to whether the barrage they are following is exactly the same as they have seen before or whether there is any difference in it—all they care about is its accuracy and efficiency. If they are occupied in watching the general form of the barrage and comparing it with other barrages under which they have attacked on previous occasions then they are not doing their proper job, viz., killing the enemy, and for that reason things may go wrong. We must guard closely against endeavour to make the battle conform to the training ground when the exact opposite should naturally be our aim.

7. A certain number of heavy guns should be placed in "lying in wait" positions well forward prior to the initial attack on an organised system so as to reach well out along traffic routes, etc. They would not open fire until after zero hour thus introducing the element of surprise and bringing fire *unexpectedly* far back along important routes.

8. It pays at times to have on a Corps front prior to an attack certain "Closed areas" into which nothing is fired. On the battle day heavy concentrations are turned on to these areas. All ranges and switches should have been worked out beforehand.

From captured documents and maps we know that the Germans carefully watch and note down any areas or routes that are free from shell fire and make use of them for bringing up counter-attack troops, etc. This system has at times given great results but must not be tried too often otherwise its value is apt to be discounted completely.

9. [MISSING LINE]

it is not for the Group Commander of the Heavy Artillery covering the Divisional front to put *forward proposals*—it is for the Divisional Staff to say *what they require to be done.*

This point wants to be driven home.

It must be remembered that although a Heavy Artillery Group is in close liaison with a Division it is still under the command of the Commander of the Corps Heavy Artillery, i.e., it is under the *Corps* control and not under *Divisional* control.

10. There is still considerable room for improvement in some instances as regards the manning of Heavy Artillery O.Ps.

Map or aeroplane shooting is apt to become an obsession. As regards the former method possibly bygone teaching at some of the Schools at Home may have had something to do with it.

This matter must be very carefully watched during Winter Training. No shoot should be done by aeroplane that can possibly be carried out by visual observation as it is wasteful of time, ammunition and flying time.

It is criminal to carry out a shoot by the map which can be done with visual observation.

11. The necessity for thickening up the creeping barrage—for having 18-pdrs. in the "combing" barrage and of further guns for *smoke* make it necessary to have a larger number of 18-pdrs. available in future operations.

This will be further emphasised if 18-pdrs. are provided with gas shell. All this points, under the organisation which exists at present, to more Army Brigades being formed.

Another matter that crops up in connection with the general question of an increase in the number of guns (on any given front) is as to whether we do not now require to add a third category to our present broad grouping into Counter-Batteries and Bombardment Batteries and have *in addition* a certain number of batteries specially told off for harassing fire.

Harassing fire particularly when, as with us, it is carried out in *addition* to other duties entails a very heavy strain indeed on the personnel, and there is no doubt, especially during prolonged operations, that the volume of fire is apt to diminish considerably in the early hours of the morning. Such a things should of course not occur but it is a matter of weak human nature and in war the human point of view and the psychological point of view must always be kept in the foreground. To ensure complete efficiency therefore there seems to be no doubt that the strength in personnel in the batteries told off for harassing fire (which, to ensure success, must be maintained ruthlessly day and night without intermission) must by some means or other be increased—in fact, practically speaking, almost doubled.

It is doubtful whether our harassing fire, taking it all round, has up to the present been sufficiently organised or taken sufficiently seriously.

12. *No alteration of or interference by subordinate Commanders with barrage tables as arranged by Corps must be allowed under any circumstances whatsoever.* It seems almost unnecessary to lay this down but cases of interference by Divisions at the last moment have occurred and in each case the result has been disastrous.

13. As a general rule, for 24 hours after the capture of a position (all objectives have been taken) the general line for the S.O.S. barrage should be that detailed for the final protective barrage. This simplifies matters and anything that tends to simplicity in battle is of the highest value: The artillery know exactly where to put the barrage, the Infantry know exactly where to expect it—all without any further instructions or notification being necessary.

This first 24 hours is usually the most critical period for the Infantry, as it is then that it has everything to fear from the counter attack of an adversary who has lost a position but not necessarily *the battle.*

A well placed and effective S.O.S. barrage is therefore of the highest importance.

14. The C.R.A. of each Divisional Artillery Group in a Corps should send an Officer (about 10 a.m.) the day before an attack to the G.O.C., Heavy Artillery, to give him all the latest available information regarding the Field Artillery barrages and the movements of the Infantry during the attack.

15. Once the time table has started Corps must not under any circumstances whatever bring back the barrage at either of their flanks without first consulting the adjoining Corps and ascertaining the most forward position of the latter's Infantry at the particular flank concerned.

16. Infantry in the line who sometimes during operations complain that the S.O.S. barrages are not put down in the right place must remember that their own Divisional Staff settles the line where the barrage is to be placed. Cases have occurred where this line has been settled in spite of protests by Artillery Officers concerned.

17. It would appear that, speaking broadly, Infantry attacks are too uncertain of success and too costly to be worth undertaking if the state of the ground is such that the pace of the barrage has of necessity to be slower than 100 yards in 6 minutes. Anything slower than this means that the state of the ground is very bad and that the Infantry find extreme difficulty in crossing it.

As far as the Infantry is concerned it is the last 50 yards after the barrage has lifted off the objective that constitutes their main obstacle—unless it is humanly possible to cover that last 50 yards in quicker time than it takes the enemy to recover himself and bring his machine guns into action, then the attack can only succeed at the expense of heavy casualties and a grave risk is run of even more costly failure.

18. Protective barrages should be heavy or not at all.

A weak protective barrage is no protection in the case of attack by the enemy and does not prevent our troops advancing before their time (if it is regarded in any way as a signal)—consequently in such a case ammunition is wasted, unnecessary wear is caused to guns and the physical endurance of the gun detachments is sapped to no purpose.

Protective barrage in *severe fighting* should be placed close in front of the Infantry and be maintained until the Infantry have thoroughly consolidated themselves.

This is not waste of ammunition.

19. The chief changes made this year in bombardment and barrage as far as this Army is concerned are contained in Appendix 1-3.

20. As was the case last year—the time to carry out intensive counter battery work is between attacks. Provided this has been efficiently done, the Infantry have nothing to fear from the hostile artillery once the attack has started until they settle down on a fixed line when deliberate counter battery work for destruction must be resumed with unrelenting vigour.

21. A battery cannot be *destroyed* in the real sense of the word. It can be put out of action for a varying length of time which however will rarely exceed a week.

22. Heavy "map-shoot" concentrations against groups or even single hostile batteries have however been of the greatest value. Even the most orthodox counter battery "purists" have been quite converted to this system after its results have been revealed by air photographs.

"Datuming" beforehand with visual observation is essential but is by no means always done, which accounts on occasions for the partial success only of these concentrations.

23. Special counter battery O.Ps. giving a good general view should be established and manned at all times and especially *during a battle*. It is only in this manner that quick and accurate information as to the effect and relative importance of the enemy's shelling can be obtained by the Counter Battery Staff Officer.

24. Liaison between the Infantry and the Counter Battery Staff Office is capable of improvement. An Officer from the Counter Battery Office should visit the Headquarters of Infantry Brigades daily and when possible Battalions in the line.

The Infantry will thus learn that the Counter Battery Staff Officer is their best friend and keep him supplied with information. At the same time, as regards this matter of liaison, the time seems now to have arrived when we should depart somewhat from the time-honoured custom of the British Army and no longer throw the whole burden of responsibility as regards liaison on the shoulders of the Artillery.

Efficient co-operation, the off-spring of close liaison, between Artillery and Infantry calls for an equal measure of intelligent initiative from the Infantry as from the Artillery. This fact is often not sufficiently realised.

During quiet times Infantry Officers should arrange to visit a Counter Battery Office and see the working of it. They would then appreciate the valuable use to which the daily periodical reports can be put provided they are made out carefully, intelligently and accurately.

As it is these reports are apt to be looked upon as merely being a rather wearisome method of gratifying idle curiosity on the part of the higher formations and an exceedingly high percentage of Infantry Officers have not the faintest conception that such an organisation as a Counter Battery Office even exists.

25. Counter Battery work is in actual practice limited by means of observation rather than by number of guns and every possible step that can be taken to increase our means of observation is therefore of the greatest value.

Too great reliance is placed on air observation which has many limitations—when for any reason air observation is not possible matters often come to a standstill and nothing is done.

26. With a view to verifying the accuracy of the air observation, the work of a Counter Battery Staff, and the actual shooting of the counter batteries, the reports sent in at the time were carefully checked with the actual results on certain German Battery positions after we had captured the ground on which they stood.

33 positions in the vicinity of LANGEMARCK, regarding the shooting on which full reports existed, were examined and checked. The results of the investigation on these 33 positions may be summarised as under:

a. Air reports more than borne out by state of target: 4 = 12%
b. Air report completely borne out: 18 = 55%
c. Air report approximately correct: 9 = 27%
d. Bad observation — M.P.I. wrong : 1 = 3%
e. Position entirely mistaken: 1 = 3%

27. There must be no confusion of ideas between the duties of F.O.Os. and those of the Liaison Officer going forward with Battalion H.Q.—the Infantry are not clear on this point and they must be taught.

Speaking broadly—the former passes orders (as regards conduct of fire) to the guns—the latter information.

The main duties of F.O.Os. are:

1. To get where they can see any counter attack that the enemy may launch, i.e., they must be far enough forward to be able, without doubt, to distinguish between friend and foe.

2. Never to relax their efforts, however great the difficulties, to establish and maintain communication with their Group or Battery.

F.O.Os. can have no prospect of success with visual signalling unless rear stations and O.Ps. keep up a continuous and effective lookout for signals from the F.O.Os.

28. Machine guns used in barrages should have their own F.O.Os. in close touch with the Artillery F.O.Os.—they should in fact work together.

29. The greatest vigilance is required from all F.O.Os. for the first 24 hours after the capture of a position. They must not hesitate to send the S.O.S. signal if it appears that Artillery fire is necessary even though no signal has been received from the Infantry. Visual signalling must be arranged for all F.O.Os. in addition to telephone communication. One F.O.O. per Group or Brigade must be provided with Runners—a post must be established on each Divisional front from which the S.O.S. signal can be repeated.

30. The final objective of an attack should be so chosen that it includes suitable forming-up places for the next attack. This incidentally would serve to dissipate the nebulous speculations often indulged in, sometimes even up to the eleventh hour, as to the actual line on which the Infantry are going to form up, and thus enable the lower Artillery Commanders to get out their final orders in time to satisfy themselves that all is right.

Time and again the definite decision on this point has been left so late that Battery Commanders on whom the main burden falls—and how heavy and sustained that burden is not fully realised—have only just been able to get their barrage tables out before zero hour is upon them.

31. The period when the Infantry are forming up is always an anxious time as regards the possibility of the enemy's artillery fire coming down; but in actual practice this year the Infantry have practically never suffered at this time and no assault has been prevented from this cause as far as the Fifth Army is concerned.

32. When Infantry are forming up for attack and the line as so often happens is not particularly well marked it is desirable to have some desultory 18-pdr. shooting going on along the opening *barrage line*—this marks down this line definitely and Infantry must form up behind it, *conforming*to it. So as not to arouse suspicion, desultory shooting on this line should take place for a couple of nights beforehand as part of the ordinary night's "Strafe".

As regards the *pace* of the barrage it should be calculated not on the state of the ground *at the time of making the plan* but what it is likely to be < the making of moment>—that is to say after the ground has been heavily bombarded for some days prior to the attack and on the actual day itself.

It is generally judicious in the first instance to assume that attacking Infantry will take the maximum time possible in carrying out any contemplated operation—as in the event of any change in time tables being made it is much easier as far as the Artillery arrangements are concerned to alter from a slow pace to a quicker one than vice-versa. In the first case the guns are left with a superfluity of ammunition which is a fault on the right side—in the latter case it means getting up more ammunition, setting more fuzes and very likely having at the last moment to re-arrange the whole of the dumps at the guns.

33. When the Infantry forming-up line for attack is in rear of a line of posts which it is proposed to withdraw for safety reasons, patrols must be kept out on the original line until the very last moment, otherwise the enemy advances into these posts or nearly into them and the opening barrage comes down behind them. Complaints from the Infantry as to our opening barrage coming down behind the enemy's front line troops have been traced back to neglect of this precaution. Nevertheless forming up in this manner will often save losses from hostile M.Gs. which have been pushed so close up that they would otherwise be safe from our opening barrage.

Above all things, though, it is *essential* that when a forming-up line has been fixed the Infantry must form up on that line and *nowhere else.*

This may seem at first sight a somewhat futile sort of instruction to lay down but it is very necessary that it should be brought home as neglect in complying with it, either from failure to grasp its importance or from other causes has more than once led to serious trouble.

34. In the absence of topographical features such as in the case of an area which has been heavily bombarded over some length of time the Infantry after a successful attack are usually extremely dubious as to how their front line actually runs. A way out of the difficulty is to put down a practice barrage on a certain definite line which is made known beforehand to all concerned. The Infantry can then pick off their position on a map by watching this barrage carefully and make any readjustments of the line that may be found necessary or possible.

This specially applies to shell-hole positions.

35. Gas shell has been found to be a very efficient method of neutralizing the hostile artillery for the last night before an attack but if our intentions are not to become patent to the enemy, these shell must be provided in greater quantity and for more natures of guns than at present so as to allow of "gassing" being carried out more frequently.

The 6" Howitzer gas shell will probably remove this difficulty if supplied in sufficient numbers.

Gas shell to be effective must be used in concentration and in large quantities. To fire isolated bursts of a few shell in hope that the enemy may thereby be induced to put on gas masks is useless and leads to waste of ammunition.

Gas shells, the effects of which although lethal are highly evanescent, are not, it is considered, so efficient as those of which the effects last for some time, and a very considerably larger proportion of lachrymatory shell seems to be required.

36. Having established a smoke screen it is often useful to fire a certain number of gas shell into the cloud.

37. When selecting enemy batteries for gassing previous to or during an attack it pays to give special attention to any that may be in action near a road.

The gassing thus serves a double purpose—neutralizes the battery and blocks the road.

38. When it is intended to carry out gassing of enemy batteries during the night, the state of the wind should be sent out to Counter Battery Staff Officers in sufficient time each evening for any special instructions as to the M.P.I., etc., to be sent out to Divisional Artilleries and Corps Heavy Artilleries.

39. Transportation for both ammunition and guns has been one of the great artillery difficulties this year on this Army front.

This difficulty has arisen to a great extent by over-bombardment not by legitimate bombardment.

Over-bombardment usually takes place owing to changes in plan and postponements—the state of the weather being, practically speaking, responsible in the majority of instances.

The bombardment for the attack of 31st of July was originally intended to last four days—it eventually lasted for sixteen days, with the result that the whole countryside was destroyed before the attack started.

40. The provision of Instantaneous Fuzes in larger numbers will assist in this matter but the effect *on our future movements* of each shell should undoubtedly be considered more in the future than it has been in the past.

41. The rate of advance of an Army in these days is entirely governed by the pace at which sufficient guns and an adequate supply of ammunition can be got forward.

So long as the enemy has a proportion of stout-hearted machine gunners and a supply of entrenching tools, so long will it be necessary for us to make use of large concentrations of artillery in supporting our Infantry. There seems to be no phase between this and the pursuit of an enemy whose moral is completely broken.

42. If therefore we are over going to pluck the fruits of victory, we must shell less lavishly or rather less *destructively*.

This can undoubtedly be done, and the enemy's moral still be shaken provided the fact is never lost sight of that moral effect is very transient.

43. The light railways are now built entirely for the Heavy Artillery and a special officer must be installed at all Heavy Artillery Headquarters charged with the sole duty of liaison with the light railways.

If the light railways are to be ready in time, Heavy Artillery Commanders must forecast as accurately as possible the future movements of their batteries and the whole general plan of the forward move must be worked out in detail beforehand.

44. When it is a case of getting forward Field Artillery ammunition with very heavy shell fore to face, a combination of light railway and pack convoy gives the best results. The light railway would allow, if possible, of loading the pack animals along a considerable stretch, thus making it difficult for the enemy to note down any one spot as a refilling point.

45. A bolder policy is required as regards pushing forward broad gauge lines—not only for the purpose of getting ammunition well forward but to enable railway mounting howitzers and guns to be pushed up without delay.

With battle-days succeeding one another much more rapidly than heretofore the enemy's artillery is forced to change position constantly—many more risks can consequently be taken as regards pushing forward our railways.

We are likely to have an accession of strength as regards long range guns on railway mountings in the future.

When now broad gauge lines are being planned on any projected battle front it is most necessary, as far as the forwards areas are concerned, to bear in mind the dictum "Railways are good Servants but bad Masters." Otherwise unless much forethought be given to the possibilities of railways from an Artillery point of view the value of the above mentioned weapons may be somewhat discounted.

46. Roads from the Artillery point of view were not so successfully pushed forward as the railways. Hence the advance of the Field Artillery was delayed and this in many cases reacted on the Heavy Artillery whose advance was also delayed since the Field Artillery in certain Sectors were occupying the only available gun positions.

The reason for this probably lies in the fact that it is not yet generally recognised that with ground in a state such as the battle field of Flanders roads *must* be built first and foremost, *to suit the Artillery,* and then used for other services as required.

It is of the highest importance that this fact should be thoroughly grasped. In no other way can the Field Artillery be got forward into proper gun positions instead of being forced to come in action anyhow on either side of the main road.

The above applies equally to the ammunition supply of the Field Artillery. The one good main road per Corps which we aimed at is unsuitable for Artillery purposes under conditions such as existed in Flanders.

The importance of good and *numerous* routes by which ammunition can be supplied to the guns cannot be over-estimated.

We have only to study the present German Artillery methods to see how they eventually copy our own methods and those of the French and we must be prepared to find that their "harassing" fire, which at present is almost negligible, will sooner or later be increased in volume enormously.

Good wide roads and a good system of light railways is therefore a sine qua non and attempts should on no account be made to move a *mass* of Artillery forward until the communications are ready to take the traffic and to *maintain* that traffic without prospect of a breakdown other than from the action of the enemy.

47. Signal methods have, relatively speaking, stood still whilst everything else has improved. Much attention should be paid to this matter and Divisional C.R.A's must give it their earnest attention.

48. As soon as an attack has succeeded a certain number of light reels of telephone wire can be taken out by aeroplane and dropped behind our new front line. These can be picked up by F.O.Os. and used for establishing communication, working backwards, which is apt to be easier than attempting to lay a line *forward.*

49. Pigeons are of very great value for communication purposes. Four pigeons should be supplied daily to each O.P. during operations. As there are probably two O.Ps. to each Group of 6 or 8 batteries this would not appear too large a number.

In any case during a battle every F.O.O. and Liaison Officer that goes forward should take 4 pigeons with his party.

50. It would seem as if far greater use might be made of balloons in connection with visual signalling back from the forward areas. More experiments in this connection would be useful.

51. On fronts where the enemy's shelling is really very heavy it is advisable to abandon all attempts to keep telephone lines intact. Visual signalling by lamp is at present the only alternative and special "concrete block" shelters should be constructed for the signal personnel directly the ground is captured.

Wireless is of course very badly needed for O.P. communications.

Most batteries require to pay more attention to the training of signallers in lamp signalling.

52. It is very necessary during prolonged operations to make arrangements for gun detachments to rest somewhere away from the actual vicinity of the guns. That is to say as far away from *noise* as possible in order that they may obtain sufficient sleep.

53. An intensive bombardment lasting several days followed by a battle constitutes a severe strain on H.A. personnel and cannot be efficiently carried out unless the most careful and well organised arrangements are made for resting both detachments and guns.

No Field Artillery should fight for more than six weeks.

Few people realise how great is the strain on the present day Battery Commander on a battle front.

54. Working as they have to do with short detachments, preparing new positions, getting up large quantities of ammunition and firing an extended programme the artillery personnel was often during the battle reduced to a state of extreme exhaustion.

55. The best system of relieving gun detachments is by making double detachments for each gun from the start, and having complete reliefs every 48 hours. To enable this to be done properly the establishment of Batteries in N.C.Os. and Gunners should be increased by 20%. This is a large increase and involves the general question of man-power but it is not the slightest use blinking at facts—the situation has got to be faced squarely. The physical endurance of the artillery at the later stages of this year's operations at times very nearly reached breaking point—next year the strain will be even greater. Such is the situation and being such it is imperative that steps be taken to cope with it.

56. The best method for providing cover for detachments in a heavily shelled area, where tunneling is not possible, is to make short length, deep, and narrow trenches 100 yards to the flank of battery positions.

Splinter-proof head cover should be added at the first opportunity.

The reasons against the provision of any more head cover than what is just sufficient to be splinter-proof are the extra labour entailed, the danger from burying in the debris, and the impossibility of making shell-proof cover under a very considerable time.

Corrugated iron with one layer of sand-bags has been found to be splinter-proof. A shell-proof for telephone operators and for a Command Post in each Battery is however necessary. It would seem that these could be provided if dug-out construction in a newly captured area was at once started well forward on a properly organised system.

Shell-proof shelters for Infantry in support etc. would then fall to the Artillery as we advance, in the same manner as the enemy's Infantry occupy old battery positions as they retire.

57. It has been found by experience and many experiments that the concealment of gun positions depends much more on the character of the ground on which they are placed than on any application of camouflage material.

Since the enemy looks to pin point our batteries on aeroplane photographs of the areas in which they have been located by flash spotters and sound rangers, it is very important that gun positions should be selected with reference to such photographs in order that, in so far as tactical considerations permit, they may be chosen as much as possible on backgrounds which are favourable to concealment.

Tracks have been found impossible to hide on any large scale. In order, therefore, that they may not indicate the whereabouts of our gun positions on aeroplane photographs, it is of the highest importance not only to choose gun positions, but also to plan (by the aid of photographs) routes for traffic along such lines as will be least conspicuous and indicative of the disposition of the guns.

Such photographs need not be taken frequently, and comparatively few suffice to show the whole of a Corps front: for a single photograph taken with a wide angle lens at 12,000 feet shows a tract of country about 2_ miles long by rather more than 1_ wide.

If this picture, which will be similar to that on which the enemy will look for out gun positions, is available at Corps and Divisional Headquarters gun positions, dumps, lines of traffic, buried cables etc. can be planned to the best advantage from the point of view of concealment, and the possibilities of the whole locality from this point of view can be studied in advance when operations are contemplated.

The occasional photographs which are taken at present of our own side of the line are of comparatively little use because, not showing the whole area, they do not afford the same opportunity of forming a comparative estimate of backgrounds, and are consequently little referred to from the proactive point of view.

58. Additional labour for both Field and Heavy Artillery is essential both prior to and during operations.

59. It is necessary to attach both R.E. personnel and special carrying parties to each Battery moving forward into a new position during battle periods. The necessity for this has been made conclusively clear and in future it should be the policy in every Corps.

60. The energy of the Artillery personnel is expended to the last ounce in getting their guns into action and above all in getting forward the necessary ammunition and it is impossible to find men for carrying R.E. material except at the expense of efficiency in the service of the guns.

61. It should be a point of honour with the Infantry not to send up an S.O.S. signal except in case of an actual attack being threatened. This should be rubbed in at all Infantry Schools. The continued and *quite unnecessary* S.O.S. calls that some Divisions make a habit of sending up whenever a German ration party is seen on the move or a few stretcher bearers appear on the scene cause an enormous waste of

ammunition, wear out the guns, tire out the Artillery personnel almost to the limits of endurance and make it a matter of extreme difficulty to build up an adequate stock of ammunition at the guns in readiness for the next battle day.

62. "Meteor" telegrams in the Fifth Army have now for a long time been sent by Army Signals direct to all Battery Commanders.

Much time is saved thereby as the message goes automatically through all the Army signals offices and never has to be re-written by any Staff Officer.

63. Low flying enemy aeroplanes are an ever present trouble. Batteries should have their own Lewis Gun detachments. It is suggested that T.M. personnel be trained in Lewis Gun for use against aircraft.

64. Batteries should not send up all their specialists into the firing battery but keep a proportion of officers and specialists back in the wagon lines so as to replace casualties—in fact follow the same system as prevails in the Infantry.

65. Ammunition stacked at any position exposed to shell fire should not be kept on wooden platforms—tin is simple and uninflammable.

66. The establishment of special Artillery "aid posts" has become necessary and will be even more necessary during next year's campaign—this must be legislated for.

It is noteworthy that the enemy has also found the same necessity.

67. As soon as the locality has been decided upon as to where an offensive is to be initiated all necessary "screening" required in view of the eventual artillery concentration should be taken in hand *at once* and completed well before the first of the new batteries are due to arrive. It is too late to leave it until *after* they have arrived.

68. The great moral in all the foregoing is that certain so-called "lessons" learnt during the Battle of the Somme led some of us temporarily astray this year, and certain "lessons" will assuredly lead us astray next year unless they are merely utilised as a basis for reflection.

As the enemy changes or modifies his methods of defence in order to hold up our attacks so we must modify or change our methods of Artillery attack in order to break down that defence, allow our Infantry to assault with a reasonable prospect of success, and gain their objective with the minimum of loss—*always bearing in mind that the final decisive factor is the bayonet of the Infantry soldier.*

"Lessons" as regards *principles* must be taken to heart and adhered to. Before applying past "lessons" as regards methods we must be quite certain that they are suitable to any altered conditions that may meanwhile have arisen.

They must then be applied with intelligence, and above all with *imagination*—which latter must be tempered by circumspection, much common sense and last, but by no means least, inter-mingled with a modicum of cunning.

There is unfortunately no golden rule which will always achieve success

27: Remarks on "Notes on the work of a Counter Battery Office," c. late 1917 (XV Corps)

Source: Uniacke Papers, RAI, U/VIII/9

1. As regards the Officers: During busy times it has always been found necessary for an additional Subaltern to be brought in to assist, in fact it is adviseable to always keep an additional Subaltern under training.

An Officer always sleeps in the C.B. Office, and the system here has been that the Officer on night duty goes on at 11.0 p.m. and comes off at 8.0 a.m. and does not come to the Office until 2.0 p.m. As a rule, even during normal trench warfare, the amount of sleep the Officer on night duty gets is negligible. Other Ranks:

One Clerk is insufficient. The following was the arrangement in this corps

One Clerk for the register
One Clerk for Intelligence Officer
Type-writing was done by H.A. Clerks.
One Draughtsman was shared between C.B. Office and H.A. Office, no difficulties experienced.
The addition of 2 intelligent N.C.Os. to assist in Activity Office is required.
During times of increased activity they are very necessary to assist in connection with shelling communications.
Three Telephonists are necessary to work the exchange. These were found from the D.A. and H.A. and worked under H.A. Signals—8 hour shifts worked very well.

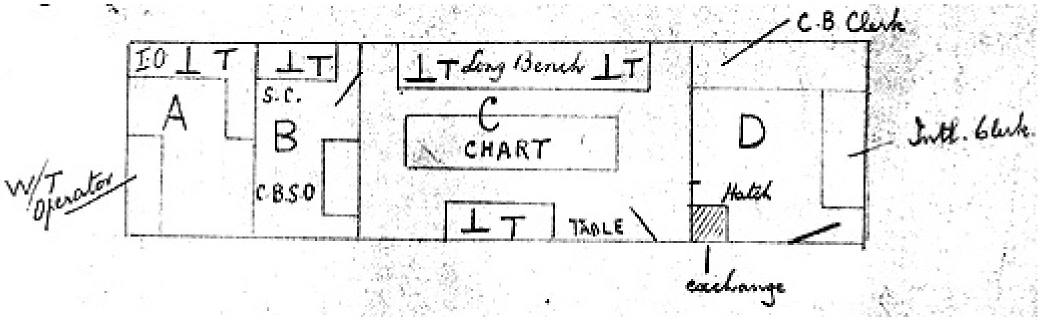
As regards the last sub-para, of para. 1:

The principle carried out in this corps was that generally speaking in a 4 Battery Brigade, 2 batteries were always available for C.B. work, 1 for Division work and 1 was in action resting, but should the occasion demand it, all batteries were available for C.B. work. A list was given daily at 5.0 p.m. by the H.A. of those batteries which were not always available for C.B. work, which might be used for C.B. work on the following day. There was never any difficulty.

3. As regards the Office, it is considered that the following is a good plan. It has been found to work well in our case

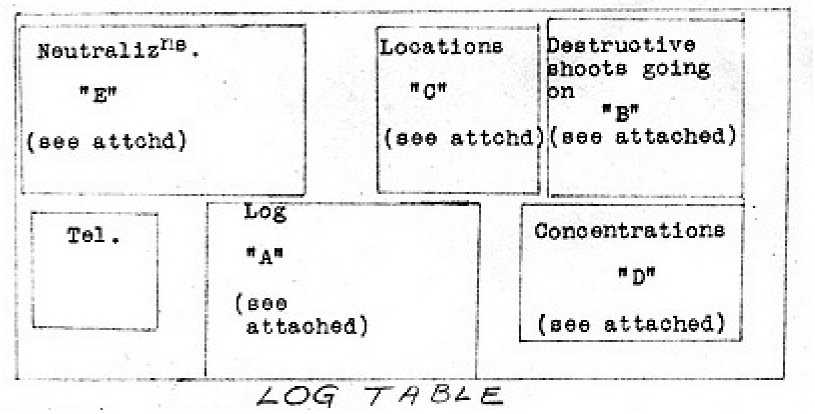
A. Office of Intelligence Officer (including C.B. W/T Operator)
B. Office of C.B.S.O. and Staff Captain.
C. Activity Office.
D. Clerks' Office and Telephone Exchange.

The mounted map should also show the position of our batteries with their arcs of fire, also all O.Ps. including Obs. "Group O.Ps." If possible the scale to be 1/10000, the radius of the arc of fire to be 1000 yards shown thus



Guns in action report is received from H.A. at 6.0 a.m. daily. A running log is kept, form attached (marked A) in connection with this log. In front of the Officer on duty is a map upon which flags are placed (a) in our areas shelled (b) in hostile batteries active from 6.0 a.m.6.0 a.m. This shows at a glance what has been happening during the 24 hours.

The Blackboard is only necessary during operations. The progress of Destructive Shoots is kept in a book, specimen page attached (marked B). The result of our own C.B. work is kept on the log table, form attached. [not reproduced]



Page 2 (Two). Communications.
A direct line to ALL Brigades (single or double) Mixed, How. and Mobile. Both on a/c of C.B. orders and Infantry reports of shelling, all Brigades R.G.A. are wired to Infantry Brigades who have a H.A. Liason Officer. It is considered that W/T is much too slow for C.B. work. Direct lines to D.A's. and to O.P. Exchanges. Direct line to Corps R.A. unnecessary—can be got through H.A. Exchange.

Para. 4.
This was not altogether the procedure in this corps. The most forward batteries of all brigades were mainly on C.B. work. Generally speaking in any one brigade, two batteries were told off permanently to C.B. work, one battery to work for the Division and one battery in action resting,

but these two latter batteries might, should the occasion demand it, also be used for C.B. work. A list of such batteries which were available for C.B. work for the following day, was given to C.B. Office at 5.0 p.m. daily.

The question of forming double groups is entirely a matter for the B.G.H.A. It is the duty of the C.B.S.O. to keep the B.G.H.A. constantly informed as to the changes in grouping of the hostile artillery, so that the latter can consider the adviseability or otherwise of altering his dispositions.

Sub- para . 4.
It has been frequently possible to take batteries in oblique (not on a salient front) and very often in dead enfilade.

Last sub-para, last line, for "through" would suggest "by"; for "should be" suggest "are".

5. Duties of C.B.S.O.

For "Policy" suggest "carries out the policy as laid down by the corps."

For Siting of Artillery: "suggests or advises as to siting of Artillery in accordance with hostile artillery movements."

Omit weekly report and enter against Intelligence Officer.

Staff Captain.

Add. Daily Report (enemy action)
(Copy of standing orders attached)

Intelligence Officer.

Omit Daily Report and add weekly report.

Orderly Officer.

Add. Shelling connections.
Daily total of hostile rounds fired (this is kept in diagramatic form and has been found to fit in very well with the activity)
The sorting out next day of all shelling reported on the daily reports and that on the log is in itself a large task.

6. Policy always changes with the situation on any portion of the front or with the situation on other parts of the front. Generally C. B. work should be vigorous and continuous whenever possible, but the actual amount of vigour varies from a variety of causes, some of which may be tactical, or it may be advisable to keep quiet to give the enemy false estimate of our strength etc. etc. Possibly it is inadvisable to lay down a

policy under 2 phases.

p. 4 sub-para. 2. Add to list "approximate arc of fire"

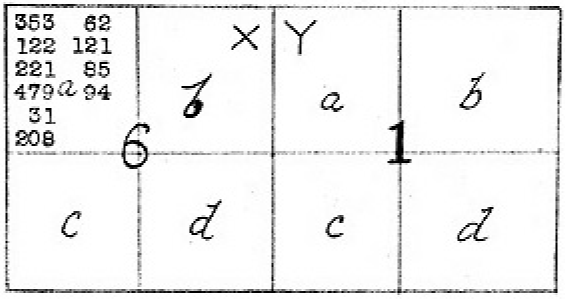
7. p. 4 sub-para. 7.

A good way of visualising hostile artillery activity is to have 10 C.B. maps put up, 7 of which show activity for each day by means of flags as follows. Assuming for report purposes the week begins on Wednesday: Coloured flags representing number of times active are required viz: 1st time active during the week—white, 2nd time—red, 3rd time—blue, 4th time—yellow, 5th time—green, 6th time—purple, 7th time—black. At the end of each week the total activity is transferred to one map, coloured flags representing times active being used, 3 weeks before the current week can thus be shown so that at any time a month's activity is before one, the current week's or latest activity always being in detail.

In addition activity sheets are very useful, specimen attached (marked F) These show hostile battery form at a glance very clearly and are most helpful.

It might here be remarked that it is very necessary to have shown clearly what our batteries can do in the way of range and arc.

If the numbers of batteries are marked (different coloured inks for brigades) on the sub-squares (of a C.B. map) which they can reach, it greatly facilitates compiling operation orders and arranging for concentrations, e.g.



As regards photographs it is considered that the system of cutting out little bits of the photo showing the actual position is not good. It is necessary to see and compare what is and has been going on in the vicinity. The card index system is quick and I think infinitely preferable. The little bits stuck on the photos look very nice but are not enough by any means. Photos should be card indexed by

e. Hostile Batteries
f. Areas (compiled from keys issued by R.A.F.)

p 5 line 9. After "intentions" and "ruses" might be added e.g. running guns, guns only firing at night, guns firing singly, a 4 gun battery having 3 silent guns and 1 gun active, dummy positions etc. etc.

To the list of indications might be added.

Alteration in grouping
Increase in H.V. gun activity
Increased aeroplane activity
Registration by 8" howitzers (21 cm)

An indication worth noting is an extraordinary number of explosions obtained during an ordinary destructive shoot.

In this connection the reconnaissance of suspicious places e.g. dumps of ammunition should be carried out; even an occasional shoot along hedges where ammunition may be stored should be reconnoitered. The most important thing is to discover the dumping of ammunition at probable battery positions, as it is now not sound to herald an attack by registration and an increased artillery activity etc. Guns will be rushed in. For corroboration of this note intended attack by Germans on Lys salient latter part of July.

The time for us to occupy Battle positions must be carefully considered. This is based largely on C.B. appreciations when there is reason to believe enemy may attack.

8. Attached a copy of this corps' C.B. standing orders.

If possible the squadron Liaison Officer should be given the next days programme by 6.0 p.m. at the latest—at any rate the bulk of it. As regards "red hot" it is necessary sometimes to take batteries on the same day and to arrange to have a plane waiting for such a shoot—"red hot" on one day, if enemy is running a lot, may be cold the next day. In fact in every squadron there should be at least one "waiting" machine always available.

Reference early morning shoots, or when the light is not too good for observation, it often happens that shoots are started and no observations are received and eventually C.I. is sent. While thoroughly appreciating the R.A.F. side of the question and realising the necessity of "trying" it appears that perhaps a weather report from an experienced observer should be sent more frequently.

As regards times of shoots it is best to let the R.A.F. name the hour; it is inadvisable to state how many shoots should or should not be done at daybreak.

Often owing to light or weather the early morning is the only time it is possible to carry out shoots.

p 6. As regards details of C.B. programme vide attached form (marked b).

The programme is wired in addition to Corps R.A., O.C. Balloon Co., O.C. Observation

Centre; the two latter can greatly assist by getting the rough off the ranging for an aeroplane shoot provided that it is assured that the plane will continue directly the balloon or observation section ceases.

A very telling form of C.B. work against personnel, is to arrange concentrations on active batteries by units that have had a registration during the day in the vicinity of the target.

There are various methods of varying the application of C.B. fire against material and personnel, the more the better.

It is important that the R.A.F. Pilots know the programme targets during operations. N.T's. on such occasions are just as important as N.F's.

Programme targets are usually classed as A, B or C.

9. Reports.

Daily reports also sent to Infantry Brigades and Divisional "G's" also Brigades R.F.A. This is very necessary if they are to take an interest in the action of our own and the enemy artillery.

Specimen daily and weekly report is attached (marked K&L).

10. Liaison.

As regards the C.B.S.O. He should "liaise" freely with Infantry Brigades and Heavy and Field Artillery Brigades.

If time and strength of staff admit, liaison down to companies should be carried out.

Whenever an Infantry Brigade is out of the line arrangements should be made for as many Officers (particularly the seniors) as possible to attend the C.B. Office for one or two lectures.

Further Divisional Artillery Officers should be attached now and again to the C.B. Office for short periods.

An R.A. Liaison Officer with the Balloons does not appear to be necessary.

The C.B.S.O. should lecture the R.A.F. Officers as required.

Amongst the duties of the Wing R.A. Officer, who should be a B.C. of some experience, might be included Lectures on elementary gunnery, systems of ranging etc. to R.A.F. Officers.

Interchange of Officers between R.A. and R.A.F. for short periods of attachment should be arranged between C.B.S.O. and O.C. Squadron

28: Principles to Govern Artillery Defensive Arrangements on the Third Army Front During Winter 1917-1918, 18 December 1917

Third Army No. G. 3/789, 18th December 1917
Source: extracted from *OH 1918,* appendices, vol. 1, appendix 14

1. Field Battery positions should not be placed too far forward, the object being merely to establish an effective defensive barrage. It must be ensured that all batteries are capable of opening a defensive barrage on and in rear of our own front line.

   Forward positions are however necessary for certain batteries detailed for counter-battery work, and also for occupation by single guns or detached sections employed for harassing fire.

   The positions of single guns and detached sections must be constantly changed. Battery positions within 3,000 yards of our own front line will be wired all round.

2. Certain single 18-pdr. guns (or captured 77-mm. if these are available) will be placed in positions from which fire is possible on to our own front system over open sights at a range of about 1,000 yards to 1,500 yards. These guns will only be fired in case of a hostile penetration of our front system by infantry or tanks; they must be most carefully camouflaged and all movements in their vicinity reduced to a minimum. Accommodation for a working detachment and for a dump of 200 rounds of ammunition per gun must be provided. This ammunition will be dumped in the proportion of 50 per cent shrapnel and 50 per cent H.E. (delay fuze).

   Not more than two such guns will be employed on a divisional front and they will be sited to cover in the arc of fire those sectors where hostile penetration appears to be the most likely and most dangerous.

3. So far as the Field Artillery are concerned all firing will, as a rule, be carried out from detached sections or single guns, the main positions being kept as quiet as possible.
4. In the case of Heavy and Siege Artillery the constant movement of single guns and sections is impossible. The principle of using only a few positions for daily trench warfare will however be observed, the remaining positions being well camouflaged and kept as quiet as possible, fire only being opened for counter preparations or S.O.S.

   Work must be concentrated on the strengthening and improvement of the positions which are in daily use. It is recognised that this strengthening must usually be limited to the accommodation provided for ammunition and personnel, as the provision of bomb-proof overhead cover for heavy guns and siege howitzers demands an expenditure of material and labour which cannot be provided.

5. An alternative position must be maintained by every Field Battery and by not less than half the Heavy and Siege Artillery, in order to provide positions for a rapid reinforcement of artillery for the protection of our existing front system, and to provide alternative positions for occupation in the event of severe hostile counter-battery work.

   This amounts in effect in IV and V Corps to maintaining in the best possible order positions at present occupied; in the case of the northern portion of VI Corps front and in the XVII Corps additional positions will have to be prepared. Map boards for such positions must be held in readiness for issue under the orders of Corps R.A., H.Q.

6. As regards construction and improvement of positions. This must be carried out on a regular system so that improvement is continuous. Sequence of work should be:
   i. Slit trenches for personnel and weather proof cover for ammunition.
   ii. Telephone dug-out and command post.
   iii. Mined dug-outs for personnel.
   iv. Splinter proof cover for ammunition.
   v. Splinter proof cover for gun pits.
7. Sufficient O.P.'s for use by a concentration of artillery, either for offense or defense, must be prepared and maintained on each Corps front. In the construction of O.P.'s concealment is the first consideration. The maximum possible amount of protection from shell fire must then be provided without sacrificing concealment.

   Cover from weather and freedom of movement are essential for good work. Maps showing arcs of vision from O.P.'s must be prepared and it must be ensured that, so far as topographical conditions allow, the whole of the enemy's territory is under close observation to a depth of at least 1,000 yards. Special O.P.'s for long distance observation will also be necessary.

8. The means of communication available for use of the artillery must be considered and systematically improved in consultation with the A.D. Signals of the Corps. When examining existing systems and considering improvements attention should be paid to the following points.
   a. Is the exchange system between batteries and between Observing Stations sufficiently good to afford facilities for the use of alternative O.P.'s by batteries? Are the connections to Kite Balloons, Sound Ranging Sections and Observation Groups sufficiently direct to allow of efficient observation of fire being carried out?
   b. Does the system lend itself to meet the demands of a rapid concentration of the artillery?
   c. Security from severance during hostile activity?
   d. Does a suitable basis exist for a rapid extension of the system forward if offensive operations are undertaken which will involve penetration into the hostile defensive system?

9. Trench Mortars must be fully used to strengthen the defensive barrage on areas especially suited to their employment.

Trench Mortars will usually be kept in defensive positions not nearer than 500 yards to our foremost line to avoid being immediately overrun in case of hostile attack. From such positions they can be used to bombard our own front line if this is temporarily occupied by the enemy. Sufficient defensive emplacements should be prepared and occupied to allow of the fire of at least two 6" Trench Mortars being concentrated on any 500 yard length of our own front line which may be temporarily occupied by the enemy.

Trench Mortars will also be the weapons principally employed for the bombardment of the hostile front system of trenches and for this purpose certain mortars will be moved up, as required, into, or adjacent to, our foremost line. Observation posts and communications must be provided for trench mortars if their full utility is to be developed.

10. The artillery barrage when units have been withdrawn to rest will be too thin if distributed evenly along the entire front.

The scheme for the opening of the barrage must contemplate its concentration in front of the most vulnerable portions of our line and on the most likely lines of hostile approach. The first of machine guns must be considered and included in the arrangements for the defensive barrage.

Counter-battery groups of Heavy and Siege Artillery will be allotted S.O.S. tasks for neutralising fire on hostile battery positions believed to be occupied.

Corps will draw up schemes for counter-preparation and S.O.S. barrage and will mutually arrange co-operation on the flanks of Corps.

Corps schemes will be forwarded to Army H.Q. as soon as complete and not later than 1st January 1918. Any difficulties of adjustment between Corps will be referred to Army H.Q. for decision. Schemes must include the action and movement of batteries, principally Field batteries, brought up as a reinforcement to cover a counter-attack on our front system.

11. As soon as all details regarding the artillery arrangements for the defence of our front system are complete, positions and O.P.'s must be selected for covering our next system of defence. As soon as material and labour are available work will be commenced on these positions in the same sequence as laid down in Section 6 above.

It may be assumed that, in the event of being compelled to withdraw to this second system, the artillery at the disposal of the Corps will be reinforced by about 50 per cent of the normal winter allotment. Routes of withdrawal to these second line positions from those covering the front system must be selected and allotted.

As soon as the allotment of artillery to the Army and within the Army to Corps has been finally settled, reinforcing units will be earmarked for each Corps from those that are withdrawn to the rest area.

Further Instructions, 7th February 1918

12. S.O.S. Barrages

. The S.O.S. lines of the Field Guns and Medium Trench Mortars should be brought back as close to our own lines as is consistent with safety.

This means that where trenches are close together the S.O.S. barrage will open on the hostile front trench or wire. Where trenches are far apart, it will open about 200 yards from our own front line. Field guns will fire 75 per cent shrapnel and 25 per cent H.E. with delay fuze.

a. Owing to the small number of 18-pdrs. available to form the S.O.S. barrage, certain portions of the front cannot be covered by fire from guns of this nature (see para. 10 sub para. 2, Third Army G. 3/789 of 18.12.17).

4.5" Howitzers using 106 fuze must be employed to assist the 18-pdr. guns and trench mortars given in sub para. (a) above.

b. Medium and Heavy Siege Howitzers will all be employed in the formation of a secondary barrage. This barrage will also be formed as close to our own line as is consistent with safety.

The maximum available proportion of 106 fuzes will be used by such batteries for this purpose.

This supersedes any instructions contained in para. 3 of Section 10 Third Army G. 3/789 of 18.12.17.

c. Heavy guns will be employed on main traffic routes in rear, or on H.Q. and communications centres.
d. Super-heavy Howitzers will be employed on counter-battery or in the bombardment of known and important command posts or on communication centres.

13. Counter-Preparations

. Counter-preparation is the action taken by the artillery to prevent the development of an attack believed to be imminent. The authorities responsible for ordering Counter-Preparation are -

i. Corps Commanders and their Staff
ii. Division Commanders and their Staff
iii. C.R.A.'s of Divisions and their Staff

a. Counter-preparation may therefore frequently merge into S.O.S. On the other hand, an S.O.S. call having been received and no attack developing, it may be considered advisable to proceed with a counter-preparatory bombardment.

b. As a further case, counter-preparation may be ordered on account of information received from deserters, agents, or any other source, quite independently of any actual call from the front line due to the action of the enemy, and in such case may be opened for a pre-determined and definite period.

c. In principle the counter-preparatory bombardment will be opened on the hostile first system of trenches and main approaches in their proximity with every available gun, howitzer, and mortar excepting super-heavy howitzers and heavy guns.

   Care must be taken that this bombardment is not diffused to too great a depth; it is designed to crush the hostile infantry assembling for attack in the proximity of the hostile first system of trenches.

   18-pdr. guns should fire 75 per cent shrapnel and 25 per cent H.E. with delay fuze--other natures the maximum possible quantity of instantaneous fuzes. Bursts of Lethal [gas] shell will be fired on suitable localities if meteorological conditions allow.

   In the event of a hostile attack being detected before it has left its jumping-off line it will be of great advantage to put down a prolonged burst of Lethal shell on the hostile front and support trenches and thus compel the enemy to attack in masks.

d. On account of the conditions mentioned in sub-para. (b) above it will frequently be advisable for the Field Artillery and Trench Mortars to open on their S.O.S. lines, especially where "No Man's Land" is wide, creeping back on to the hostile first system of trenches.

14. Artillery action in event of a prolonged hostile bombardment. Owing to the necessity of reserving the available stocks of ammunition at the gun positions to meet the actual attack, it will not be possible to maintain indefinitely a heavy counter-preparatory bombardment if it becomes evident that the enemy is engaged only in his preparatory bombardment. Under these circumstances the artillery action will consist of -

. intense counter-battery work, gas shell being freely employed, and

i. harassing fire on roads to hamper replenishment of ammunition and the approach march of the troops destined to carry out the attack.

Gas shell will be employed in favourable localities when meteorological conditions are suitable, but the tendency to scatter these shell in insufficient concentration must be carefully guarded against, or all effect is lost. Counter-preparation will on occasion merge into action such as is outlined above. On the other hand all artillery units must be prepared to at once take up their counter-preparation or S.O.S. tasks on receipt of a message or order, or on seeing the appropriate signals.

15. Preparation of positions for reinforcing artillery.

It is impossible to lay down the exact amount of artillery reinforcements which may be expected. The Third Army Defence Scheme Part III gives the maximum which can arrive in the first 96 hours. Corps must therefore be prepared to receive this artillery. The maximum would only be sent to one Corps when the limits of the attack are already defined, and it is shown that the enemy's intention is to break through on that front.

In this case some artillery would be kept out of action so as to be available as a reserve to be moved where required.

The actual number of unoccupied positions which have to be prepared and maintained are as follows:

. For reinforcement of artillery to defend present first system 100 per cent reinforcing positions for field artillery and 50 per cent reinforcing positions for heavy artillery to be maintained by batteries actually in the line; this includes Brigade H.Q. dug-outs.

i. The strength of artillery for defence of 2nd system will be taken to be:

Actual Strength. This includes any reinforcements received and any artillery at rest whether temporarily in G.H.Q. Reserve or not, plus the following reinforcements:-

Heavy Brigades R.G.A.
V Corps - 6, 2 Mixed, 2 9.2", 1 8", 1 Mobile
IV Corps - 6, 2 Mixed, 2 9.2", 1 8", 1 Mobile
VI Corps - 8, 2 of each sort
XVII Corps - 4, 1 of each sort

Field Artillery
V Corps - 2 Div. Arties. 2 Army Brigades R.F.A.
IV Corps - 2 Div. Arties. 2 Army Brigades R.F.A.
VI Corps - 2 Div. Arties. 3 Army Brigades R.F.A.
XVII Corps - 2 Div. Arties. 1 Army Brigades R.F.A.

In siting batteries for the defense of the 2nd system, regard must be had to protracted operations throughout the Battle Zone, and batteries must be distributed in depth so that operations may be conducted throughout this zone with the minimum of movement of batteries. As the Battle Zone varies considerably in depth along the Army front this must be regarded as a principle only, to be adapted to the local conditions on each Corps front.

ii. As regards the Rear Zone. A scheme showing Corps and Divisional boundaries on the Rear Zone will be issued to Corps. Reconnaissances of artillery areas have already been furnished by Corps. Further orders will be issued as to the distribution of artillery and selection of positions for the Rear Zone.

16. As regards the sequence of work.

. The general reconnaissance must first be completed including the position of Brigade Headquarters and the grouping of the artillery which will be at disposal settled.

a. Work on positions for the Forward and Battle Zones will be carried on simultaneously. Further instructions will be issued regarding work on the Rear Zone when the question of provision of labour has been thoroughly investigated and settled.
b. All positions will first be marked and the work of provision of artillery boards put in hand. Construction of O.P.'s will then be commenced. O.P.'s must be constructed in depth throughout the Battle Zone.

When positions of Headquarters, Batteries and O.P.'s are fixed, the work of digging in the main lines of telephone communication will be undertaken, under a scheme to be prepared in collaboration with Corps Signals. The existing telephonic system will be utilized as far as possible. Brigade and Battery command posts and telephone dug-outs should then be constructed. Ammunition recesses with weather-proof cover will next be made, and finally slit trenches for personnel.

The ground at the actual gun positions should not be broken until it is possible to erect weather-proof cover over the pits. <P

17. Points to be considered in the preparation and execution of Defence Scheme.

. It is impossible to foresee and provide for every contingency. The initiative of Brigade and Battery Commanders must not be too much cramped by the allotment of fixed positions either to fall back to, or to advance to, if they happen to be in reserve at the time of attack. Brigade and Battery Commanders must be ready to vary their dispositions at once if the direction of the hostile attack changes during the course of operations from that contemplated in the scheme. Batteries already in action must be ready for a complete change of their arc of fire due to the development of operations.
a. Brigade and Battery Commanders and their Staffs, of Artillery in Corps Reserve, should go over the various counter-attack schemes on the ground. Effective artillery support to the counter-attack demands most prompt and resolute action and individual initiative on the part of Artillery Commanders down to Battery and Section Commanders.
b. O.P.'s must be provided in depth. O.P.'s close to the present general alignment of batteries will serve as back O.P.'s for the defence of the first system, and as forward O.P.'s in the event of a hostile penetration of the First System and so on. All batteries should select, and prepare with suitable communication and cover, an O.P. in close proximity to the battery to enable hostile Tanks and Infantry that have penetrated our defences to be engaged at close range, provided that the trajectory admits.

Brigade Commanders should establish O.P.'s in the vicinity of their own H.Q. from which they can if necessary get a general view of the country, and ascertain the progress of operations. At the junction of Corps areas particular care is necessary to ensure that all back areas are under proper observation.

18.

Anti-Tank Defence.

Draft instructions for anti-tank defence were sent to G.O.'s C, R.A. of Corps on 8.1.18; the final G.H.Q. instructions on the subject are still awaited. Meanwhile attention is drawn to the following points:

Anti-Tank Defence must be organised in depth.

. The distant area, i.e. while tanks are moving up into or are halted in their assembly positions.

Main reliance must be placed on the R.F.C. to locate and report tanks in this area. They will be engaged by the artillery according to the instructions contained in S.S./131 "Co-operation of Aircraft with Artillery."

i. The barrage area. The S.O.S. barrage will be thickened and made as dense as possible by the inclusion of all pieces except super-heavy howitzers and heavy guns.

ii. The forward gun area. It is important that the specially placed forward anti-tank guns should have a wide arc of fire. It will usually be best merely to camouflage these guns; they are then capable of firing in any direction.

iii. The defensive battery area. In every 18-pdr. battery and in certain selected 60-pdr. batteries one or two guns, usually the flank guns, will be told off and held in readiness to be run out and to fire direct with H.E. at the tanks.

iv. The Mobile Reserve Area. Positions must be selected for occupation by sections of 18-pdrs. brought up from the Corps local reserve on the first warning of a tank attack. These positions will be selected with a view to the engagement of the tanks over open sights, after they have just passed through the main line of our field artillery positions. Routes must be carefully reconnoitred

29: Fifth Army winter artillery guidelines, 1917-18, 27 December 1917

Source: Uniacke Papers, RAI, U/VII/3

SECRET

ARTILLERY INSTRUCTIONS NO. 83
Headquarters, Fifth Army
27th December, 1917

1. As it is essential that the artillery should get as much rest and training as possible during the winter and in order that work on defences may progress as much as possible with the minimum number of casualties, Artillery action for the present is to be limited strictly to what is considered necessary for the defence of the line.
2. "Harassing" fire at night will be stopped for the time being—except in the case when reliable information is forthcoming that a relief is in progress.
3. No *desultory shooting*, either on trenches or batteries, will take place. The only shooting that might be classified under the headings of *desultory* should be to check the lines of fire, any *necessary* registering and checking of the error of the day on datum points.

   It should be noted that it is possible to over—check barrage lines &c. and thereby give away valuable information to the enemy.

4. The enemy's trenches will not be bombarded except in case of necessity and then only when observation is possible.
5. When, however, the action of the enemy becomes so aggressive as to render reprisals desirable, these reprisals should take the form of fully organised, fierce and concentrated bombardments, lasting a certain definite time and placed on selected portions of the enemy's organisation where damage is likely to be caused. When carrying out reprisals in this manner trenches should never be bombarded without a determined effort being made to destroy something definite—Machine Gun or Trench Mortar emplacements, dug—outs, etc.

   Care must also be taken not to shell empty trenches with shrapnel: the enemy does not ordinarily occupy his front line very thickly by day, consequently to shell his front line holds out, under ordinary circumstances, very little prospect of killing Germans and therefore fails to fulfil its main object.

   As regards the enemy's artillery, in this connection, it is best to select one hostile battery and turn the full weight of the counter batteries of the Corps on to it and smash it rather than to distribute fire simultaneously over a number of batteries.

   Whenever a destructive shoot of this nature, whether it is in connection with reprisals or in the ordinary course of counter battery work, has taken place, shrapnel fire should be kept over the destroyed emplacement for the next few days in order to catch the salvage parties if possible.

6. In order to carry out the principles laid down in G.H.Q. Memo on Defensive Measures (O.A.D. 291/29 dated 14th December, 1917) together with the Army Instructions which have already been issued on this subject it is necessary that the batteries, both of Field and Heavy Artillery, on each Corps front should be echeloned in depth and placed chequer—wise so that if the enemy should break through on a wide front all our guns are not put out of action at the same time.
7. Until such time as offensive operations are to be resumed by us, the Artillery of the Army will be placed purely defensively and in such a manner, consistent with para. 6, that the following two main tasks can be carried out:—

   1. In the event of the enemy showing signs of attacking—to place a Field Artillery Barrage 250 yards in advance of our front system with a Heavy Artillery barrage behind it.
   2. In the event of the enemy breaking through our front system—to hold him to the ground gained and inflict heavy casualties on him until such time as our counter attack Divisions accompanied by mobile batteries can be brought up.
8. One or two 18—pdr. Batteries per Divisional Sector should be placed about 5,000 yards behind our front line in strong emplacements with good fields of fire.

   These batteries will remain silent, their task being to support the counter attack in its initial stage whilst the mobile batteries are getting into action.

   The siting of them, therefore, must receive the most careful consideration.

9. Efficient Artillery support to the counter attack will require the most resolute action and exercise of the highest form of initiative, and Artillery Commanders down to Battery and Section Commanders must be trained to act, when the occasion arises, independently and with complete self reliance.
10. The only exception to the principle laid down in para. 7, which involves siting our guns well back, is that a certain number of counter batteries will have to be kept in fairly forward positions in order to carry out routine counter battery work, mainly with a view to assisting in training air observers.

    Once it is made perfectly clear that the hostile attack has been launched, by the fact that the enemy's infantry is seen advancing, the work of these counter batteries, as such, will cease and their whole energies be devoted to breaking up the enemy's infantry organisation.

    Our latest experience has been that the enemy's infantry advances in mass with a view to overwhelming all resistance by sheer weight of numbers.

Extraordinary opportunities are, under such conditions, offered to well handled and resolute Artillery to inflict very heavy losses and to break up the attack completely.

11. The importance of siting Field Artillery in such a way as to avoid any dead ground cannot be over—estimated.

Arcs of fire must be as wide as possible and gun pits constructed so that guns can be put in and taken out without difficulty as fire may be required in any direction.

12. All batteries must be properly dug in, wired all round and camouflaged. The positions should be so organised as to afford suitable rallying points for Infantry, should occasion arise, and be capable of Machine Gun defence.

13. Every battery in the line must prepare and maintain a second position for a "reinforcing" battery of the same nature.

The position must in the first instance have weather proof cover for ammunition prepared and a shell—proof telephone dug—out and Battery Command post.

Shelters for personnel can then be started as time and labour become available. The necessary O.Ps. for these positions must be selected and made, and "Battery Boards" prepared.

It is essential that the positions should be most carefully camouflaged.

14. Too little time and care is not to be given to concealing batteries from the air.

Camouflage must constantly be improved and the result checked by means of air photographs.

All blast marks must be carefully obliterated or concealed.

Tracks and tramways should never stop at a dead—end in the Battery but be continued on into a dummy position a short distance off.

15. The "reinforcing" positions mentioned in para. 13 are in addition to and must not be confused with "alternative" positions which all batteries, especially Field Artillery, should have ready for occupation.

When indications are clear that the enemy has discovered one of our battery positions, alternative emplacements should be occupied, if possible, before his destructive shoot begins.

16. It is advisable to keep a single gun or Section well away (100 to

400 yards) from the real position of the battery. Its emplacement should be as strong and well concealed as possible. All ordinary shooting should be carried out from this position so as to conceal the real one.

A certain number of isolated shelters for storing ammunition and other purposes should also be built away from the actual position.

17. Mobile "roving" guns which wander about and fire from different positions especially at night when the flashes can be detected and serve to mislead and mystify the enemy. This must however be done with circumspection and not too often otherwise the ruse may give rise to suspicion.

18. If any emplacements have been abandoned owing to hostile fire they should occasionally be fired from.

19. Every battery must establish and organise an O.P. in close vicinity to its gun position, ready to be occupied should the enemy succeed in breaking through our forward line of resistance.

In some cases it may be necessary to have more than one of the O.Ps. available in order to deal with any of the varying situations that may arise.

20. Artillery O.Ps. in the backward areas must be selected and tabulated in connection with those gun positions chosen for the support of each successive rear line of resistance.

Steps must be taken so that no portion of the foreground will be left unwatched. Special care is necessary at the boundaries of Corps areas where each Corps must in this matter work in close conjunction with its neighbours.

21. Every Group Commander, whether of Field or Heavy Artillery, should establish an observation station for himself in the close vicinity of his Headquarters whence a general view of the country can be obtained and from which he can, if necessary, see for himself what is going on in his immediate front.

A "crow's nest" in a tall tree will often meet the case.

22. "Dummy" gun emplacements often serve a most useful purpose. The usual fault is that they are much too obviously dummy. The whole matter requires most careful stage management and to be of real value dummy emplacements must resemble real emplacements down to the smallest details.

On fine days when hostile aeroplanes are about fires should be lighted close to them so that the smoke can be seen.

Tracks leading to them should be made and even short lengths of tramway laid. Now and again "roving" Sections or guns should actually fire from them.

Most particular attention must be given to imitating blast marks—as they are one of the things most apt to give away a concealed position on an air photograph. The absence of blast marks leads to the presumption that a position is not occupied.

It must be realised that the blast mark of a Howitzer differs from that of a gun.

It is obviously useless to erect a dummy emplacement suitable for a 12" Howitzer and show a blast mark which would ordinarily be made by an 18—pdr. gun.

23. It is useful to keep a small supply of smoke candles in the dummy position.

When the enemy has engaged one of these positions the fact of lighting a few smoke candles and a couple of small fires to represent the usual explosions and fires in the gun pits is apt to give great satisfaction to the hostile air observer and often induces him to return home rather sooner than he otherwise would have done.

24. Firing dummy "flashes" from false positions when his aeroplanes are about helps to mislead the enemy but it must be realised that it is no use firing dummy flashes unless a real battery is firing at the same time.

A succession of "flashes" on our side combined with an entire absence of shell bursts on the enemy's side merely degenerates into a somewhat indifferent pyrotechnic display serving no useful purpose whatever.

25. Every Artillery O.P. that is manned by night will be provided with a complete outfit of S.O.S. light signals and these light signals will invariably be used in addition to any telephone message or other signal that may be sent out.

"Repeating Stations" are to be established wherever necessary. The rapid transmission of "alarm" signals to the guns requires even more care and forethought than ever to be exercised to ensure efficiency whilst the present defensive phase is in existence, owing to the greater distances over which the messages will have to travel.

The only sure test of a really efficient system is when messages can get back to the guns at once even though the weather is foggy and the telephone has broken down.

26. The foregoing instructions refer mainly to the present defensive policy but the fact must never be lost sight of that this is a mere temporary phase to be followed eventually by a resumption of the offensive.

Consequently though, for the moment, the strengthening of our rear defences and the rest and training of personnel is of paramount importance, yet gun emplacements etc. already established in the forward positions must not be allowed to fall into a state of decay, as their eventual re—occupation will almost certainly become necessary at some future date. If handed over in good repair they can, without in any way detracting from their eventual value as gun positions, be organised into Infantry strong points and incorporated into one of our defensive lines.

Whenever such a system is adopted—whether it be the conversion of an old gun position into a strong point, or the adaptation of an Infantry strong point in any of the rearward lines so that it may eventually be utilised as a gun position, an Artillery Officer should invariably be detailed to see that the work carried out is suitable from the Artillery point of view.

27. ACKNOWLEDGE

[signed] H. Uniacke
Major General,
G.O.C., R.A., Fifth Army

Distribution
Copy No. 1 and 2 Fifth Army "G.S."
3 D.A. & Q.M.G.
4 VII Corps
5 VII Corps Arty.
6 Cavalry Corps
7 Cavalry Corps Arty.
8 XVIII Corps
9 XVIII Corps Arty.
10 5th Brigade, R.F.C.
11 G.S. Intelligence
12 Third Army
13 Third Army R.A.
14 Captain Renondeau
15 Third French Army
16 M.G.R.A., G.H.Q.
17 5th Balloon Wing
18 15th Wing, R.F.C.
19 Fifth Army A.A. Group
20—21 Filed

30: Birch's Report on Artillery in Defense, 10 February 1918

Source: Rawlins Papers, RAI, file 12b

Secret
RA./G/5
10-2-18

C.G.S.

1. On the afternoon of the 8th February I proceeded to ABEELE and attended a lecture given by the Fourth Army Commander on the Battle of CAMBRAI to his Corps, Divisional, Commanders and their staffs. The Army Commander in concluding said that the lessons to be learnt from the CAMBRAI Battle were as follows:
    a. (a) Divisional boundaries should be arranged so that the Divisional reserve can be directly behind the Division. This is not always possible in a salient.
    b. That the LATEAU WOOD Ridge was convex in shape like all chalk ridges and that as the passages over the Canal S.W. of it had not been secured, frequent patrolling, both by night and day, was necessary; and that this apparently had not been carried out.
    c. That defence should be in depth.
    d. The handling of artillery in the defence.
2. I should like to speak to you concerning this last point, and I trust that Artillery Notes No. 7 - "ARTILLERY IN DEFENSIVE OPERATIONS" now in galley proof, if approved, will be issued as soon as possible.
3. I suggest that the G.Os.C., R.A., of Armies should attend the next Army Commanders' Conference and that the handling of artillery in the defence should be discussed in rather more detail than is set out in the Agenda for that Conference; in fact the "ABC" of the matter should be threshed out. It will be laid down in our manual, if the Field Marshal approves, that the basis of artillery action in defensive operations will be as follows:
    a. The defence scheme will be made out by the Corps in consultation with the Divisional Generals.
    b. A certain amount of Heavy Artillery will be attached to each Division.
    c. In the event of the Corps being attacked, the barrage will come down as arranged by the Corps, but the actual command of the Field Artillery and of the Heavy Artillery attached to the Division will remain in the hands of the Divisional Commander, until such time as the Corps consider that centralised control will give better results.

d. The rest of the Heavy Artillery of the Corps will during the period of general counter-preparation be employed under Corps orders in counter-battery work, bombardment of rearward communications and harassing fire. If an attack appears imminent, the majority, if not all, of this remaining Heavy Artillery will co-operate in annihilating fire on points where the enemy's attacking troops are seen or are believed to be massing. At the moment of assault, every single weapon of the defence will be devoted to barrage fire, i.e. to the destruction of the assaulting forces. All tasks and targets for annihilating and barrage fire must be definitely allotted beforehand in close consultation with Divisional Commanders.

e. Reinforcing artillery will be dealt with by the Corps as the situation demands. Normally the Field Artillery will be at once allotted to Divisions.

4. On the 9th February, I visited all the Heavy Artillery Headquarters in the Fourth Army and all the Counter-Battery Offices.

The enemy's artillery is certainly very quiet now on the Fourth Army front, except for occasional activity opposite the VIII Corps. I cross-examined all the Counter-Battery Officers as to whether they considered that any hostile artillery had left their front during the last 3 weeks; they all said that they thought not, though it was very difficult to be sure at this time of year. General Budworth did not consider that there was sufficient evidence to prove any reduction in strength in the enemy's artillery. However, I gathered that many of the active positions were only occupied by one gun; this of course may be regarded as the enemy's normal procedure in using a gun some distance away from the battery for ordinary routine firing. I further gathered that in a recent raid on the XXII Corps front hostile artillery fire was far from being heavy, though the airmen reported a great many flashes.

I examined some photographs of our gun positions and camouflage was not successful. I will speak to the E.-in-C. [Engineer-in-Chief] about this.

G.H.Q.
Major-General, R.A
10/2/1918

31: SS139/3, Artillery Notes Number 3, "Counter-Battery Work," February 1918

Source: IWM SS/CDS Pamphlet collection

(To be studied in conjunction with "Co-operation of Aircraft with Artillery" (S.S. 131, revised edition, December, 1917), "Artillery Notes No. 4 - Artillery in Offensive Operations" (S.S. 139/4, March, 1917) and "No. 7 - Artillery in Defensive Operations" (S.S. 139/7, February 1918), issued by the General Staff)
February, 1918

Note. The assistance afforded by the Royal Flying Corps is essential to successful counter-battery work. S.S. 131, "Co-operation of Aircraft with Artillery" deals fully with subjects touching the co-operation of R.A. and R.F.C. in counter-battery work, as well as in other tasks, and must be read in close conjunction with these Notes.
"Artillery Notes No. 4 - Artillery in Offensive Operations" and "No. 7 - Artillery in Defensive Operations" must also be studied with this book.

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I. THE IMPORTANCE OF COUNTER-BATTERY WORK.

1. During the course of the present war the importance of counter-battery work has become more and more accentuated. For just as artillery forms the main support of the offensive, so

also is it the strongest weapon of the defence. Destruction of the enemy's artillery is a most important factor of success, from both a moral and material aspect. Every hostile battery destroyed is one step gained, and destruction of the enemy's artillery must not be left to the eve of a battle, nor neglected till the enemy attacks.

The struggle against the hostile artillery must therefore be the constant consideration of Commanders.

Counter-battery work is not a matter of spasmodic effort, but is a continuous operation depending for success on accuracy of fire, continuity of plan, unremitting study and firm control. Its conduct on these lines will alone meet the end in view, namely, the considerable if not total reduction at decisive moments of the volume of hostile artillery fire, whether in the form of preparation for an assault, counter-preparation to meet attack by our own troops, or barrages offensive and defensive.

Unless the enemy's batteries are discovered and destroyed, not only may his barrage fire render the capture of an objective difficult and costly, but his subsequent bombardments may make its retention impossible.

The enemy's counter-battery work has recently been greatly developed on lines closely akin to those adopted by us, and it has become a factor very much to be regarded. The weight of his artillery fire has on the whole been thrown against our batteries, chiefly in the form of more or less concentrated fire against artillery areas, and against our communications with both gas shell and high explosive.

The "artillery duel" has in fact re-appeared and has become a highly important feature of the period just previous to and during active operations; and there is every reason to anticipate that the enemy will in the future redouble his efforts to reduce the power of our artillery.

II. ORGANIZATION AND COMMAND.

2. The General Officer Commanding Royal Artillery of the Army is charged with the co-ordination of all artillery action both in offence and defence, and he should pay close attention to counter-battery work.

Working in close touch with the General Staff he submits to the Army Commander his proposals as to the extent of the Corps counter-battery areas and also as to any subsequent modifications necessitated by considerable movements of the enemy's artillery. It is particularly his duty to ensure that hostile guns situated in the counter-battery area of one Corps, but firing on the front of another, are adequately dealt with, for it will seldom be found that the whole of the hostile artillery which fires on the infantry and guns of any one Corps is situated within the counter-battery area of that Corps.

The Army must be kept fully informed as to the counter-battery situation, so that mutual assistance between Corps may be fully effective. To ensure this the counter-battery front of an Army must be considered as a whole, and it may therefore sometimes be necessary to site a portion of the artillery of one Corps in the area of another (see Section VI., 42) or even of one Army in the area of another.

It must be borne in mind that the boundaries between Corps are laid down by the Army to suit their infantry resources, and that the allotment of counter-battery areas therefore depends largely on the Corps frontages and also, of course, on the grouping of the hostile artillery.

The G.O.C., R.A., deals direct with the Brigadier, R.F.C., in all matters relating to the combined work of Artillery and Royal Flying Corps, and works in close touch with the General Staff (Intelligence) and Field Survey Company in all matters affecting artillery intelligence.

3. The General Officer Commanding Royal Artillery of the Corps, also working in close touch with the General Staff, is responsible in a similar manner to the Corps Commander, whose instructions he issues direct to the Corps Heavy Artillery and to any Field Artillery directly under his command. He is, therefore, at all times responsible to the Corps Commander for the counter-battery work of the Corps. He deals direct with the Corps Squadron and Balloon Company Commanders in all matters connected with the combined work of the Artillery and Royal Flying Corps. The Corps and Balloon Wing Commanders are, however, the executive commanders of the Corps Squadrons and Balloon Companies respectively, and, as such, act as the technical advisers of General Officers Commanding Royal Artillery of Corps, with whom they should be in closest touch. The General Officer Commanding Royal Artillery of the Corps lays down the general counter-battery programme, both with regard to the destruction of the enemy's artillery, which must be systematically and persistently sought after, as well as for general neutralization, which at times may become a matter of necessity, as, for instance, at the moment of the infantry assault or in the face of a heavy hostile bombardment. This programme must include any share in counter-battery work that the Field Artillery may be called upon to take up.

4. Apart from such orders as may be issued by the Army as regards co-ordination of counter-battery work between neighbouring Corps, the General Officer Commanding Royal Artillery of the Corps must arrange with those of Corps on either flank for immediate assistance from their batteries whenever it becomes necessary to deal with artillery outside his Corps area which is punishing the infantry or impeding their advance. Corps must keep the Army fully informed as to the counter-battery situation.

He is further responsible to the Corps Commander for the allotment of ammunition and its proper expenditure to the best advantage. He exercises a constant control over the action of his counter-batteries, assuring himself by frequent visits, as far as his other duties allow, to brigades and batteries, that fire is conducted on sound lines, that the means of observation and communication are both adequate and satisfactory, and, by study of air photographs, that the fire is accurate and productive of results.

5. The Brigadier-General, Commanding Corps Heavy Artillery, is the executive commander of all the heavy and siege batteries allotted to the Corps. In each Corps a Counter-Battery Staff Officer is responsible for the organization and execution of counter-battery work in accordance with the instructions of the G.O.C. R.A. of the Corps, and it is his duty to ensure that all information of immediate value is passed to the batteries concerned. In cases where the organization of the artillery for counter-battery work consists of several brigades, it is of considerable assistance if groups can be formed so that the number of individual commanders to be dealt with is reduced.

Counter-battery orders will specify the tasks to be performed, the ammunition allotted, and the aeroplanes to be placed at the disposal of batteries, in accordance with the directions of the General Officer Commanding Royal Artillery of the Corps.

A daily report on the hostile artillery and on the work carried out by the counter-batteries of the Corps will be forwarded to the G.O.C. R.A. of the Corps and to such other Headquarters as may be ordered.

6. The object of this organization, whatever its details may be, is to ensure a methodical and permanent system of counter-battery work, which in the actual battle plays a capital role.

Particular care must be taken to ensure that the counter-battery action of the Artillery of the Corps shall not degenerate into the spasmodic fire of independent batteries dependent on the individual ideas and energy of their Commanders.

7. The assistance in counter-battery work that can be and is afforded by the Royal Flying Corps is beyond dispute. Accurate artillery fire is to a great extent dependent on good observation, and this in many instances can only be obtained from the air. The closest personal touch between the Artillery and the Royal Flying Corps is a matter of the first importance. Difficulties and occasional failures will occur, but their recurrence can best be obviated by frequent interviews, both before and after work, between officers of the two arms concerned. (See S.S. 131, para. 16 (d).)

At the same time, artillery must not look upon the aeroplane as an essential to successful fire, particularly as regards counter-battery work. Correct use of datum points, calibration, calculations for the error of the day, thorough and accurate intelligence as to hostile batteries and careful intersections of our own battery positions will, granted good gunnery, render it perfectly possible to deliver an effective fire on occasions when aeroplanes cannot work or are not available. On such occasions recourse may also be had to accurate instrumental observation from two stations, for which purpose it is not necessary that the target should be visible, so long as the bursts of the shell can be observed. If a hostile battery has been accurately located by bearings, this method should give good results.

Sound ranging has also become a valuable and practicable method, in certain conditions, of ranging our own batteries, and is being still further developed in this respect.

Good effect may be obtained against the enemy's artillery by means of a carefully organized system of concentration shoots. (See Section V., 27.) It is to be clearly understood that, whatever be the counter-battery programme ordered for any particular day, arrangements must be such that any hostile battery (not included in the programme) reported as active, either from the air or from the ground, can be immediately engaged.

All means of observation must be fully considered and carefully organized. Observation from the air and the possibility of delivering an accurate, though unobserved, fire by means of calculations have perhaps tended to belittle the value of direct observation from the ground.

Whenever hostile batteries can be seen active from ground observing stations, they should be promptly engaged without waiting for other means of observation. Direct observation from the ground is particularly to be looked for when the progress of a battle brings possession of commanding ground with a good view of hostile territory hitherto unseen except from the air.

8. Corps Counter-Battery Areas.—The front of a Corps is allotted by Army Headquarters, and each Corps is made responsible for certain areas as regards counter-battery work. The Corps counter-battery area, though clearly defined for normal working purposes, must be regarded as elastic. An overlap on either flank will almost always be necessary, so that mutual co-operation between adjoining Corps will be facilitated. The same principle of elasticity must be observed in allotting areas to groups or brigades.

9. Communications.—The system of communications for counter-battery work must be carefully studied if efficiency is to be ensured and waste of material avoided. Counter-battery formations should, as far as material allows, be in direct communication with similar formations on either flank, the Corps Squadron and Balloon Company, the Observation Groups and Sound-Ranging Sections, and with the Artillery of Divisions in the line; for without such communication quick transmission of information and orders is impossible, and, consequently, rapid application of effective fire.

III. THE ALLOTMENT AND SITING OF ARTILLERY.

10. Allotment of Artillery.—While definite brigades must be detailed for normal counter-battery work falling within the scope of the Army or Corps programme, it is clear that the actual number of guns required will and must vary in accordance with the needs of the tactical situation.

It is the duty of the Army or Corps Commander, as the case may be, to lay down from time to time the amount of artillery to be devoted to the destruction or neutralization of the enemy's batteries.

But unless the counter-battery programme states what batteries are to be employed on this work and aims at avoiding unnecessary changes, within such limitations as can be foreseen, co-operation on the part of the Royal Flying Corps will be rendered far more difficult, and the great advantage that accrues from personal understanding between Royal Artillery and Royal Flying Corps officers will be largely sacrificed.

The actual allotment of batteries for counter-battery work depends on the following considerations.

Both guns and medium howitzers are required for neutralization.

6-inch howitzers are very effective for neutralizing fire, though not always powerful enough to destroy long-established and well-constructed emplacements; they are of great value in an advance when the enemy's guns are forced back into positions more or less hastily constructed.

For destructive work heavy and super-heavy howitzers are required, and of these the 12-inch howitzer has proved particularly effective. Howitzers of long-range patterns should naturally be reserved for counter-battery work.

Long-range guns (6-inch and upwards) may on occasion have to be employed for this purpose, but their comparative inaccuracy at long ranges, and the very short life of guns of 9.2-inch calibre and upwards, place a great restriction on their utility as counter-battery weapons.

A proportion of the available Field Artillery can be usefully employed in the counter-battery work of the Corps. The employment of field howitzers for this service should be particularly considered in all artillery plans, as these weapons are provided with gas shells.

Field guns (13 and 18-prs.) with their rapid rate of fire can give great assistance in neutralizing the nearer hostile batteries; their value in this respect is perhaps apt to be overlooked, owing chiefly to the fact that there are so many calls upon them in the actual battle.

11. Siting of Batteries.—On all occasions it is essential that an adequate number of counter-battery howitzers and guns should be sited well forward; this is particularly important when preparing for offensive operations (see Section VI., 42 (b).)

Every endeavour should be made to exploit the use of oblique and enfilade fire, as in every case the breadth zone of a gun or howitzer is much less than its length zone, and the chances of obtaining direct hits are therefore greater as the obliquity of the line of fire to the target increases.

The advantage of cross-fire will be gained if it can be arranged that each brigade or group engaged in counter-battery work shall have at any rate one outlying battery. But the control of all batteries devoted to any one area must be vested in one man.

IV. LOCATING AND RECORDING THE POSITIONS OF HOSTILE BATTERIES.

12. Information as to Hostile Batteries.—In order that the hostile artillery may at all times be engaged with accuracy and certainty of effect, every source of information regarding the enemy's battery positions, their activity, their ammunition supply routes, etc., must be thoroughly and constantly studied and all records must be kept up to date.

The recent tendency of the enemy to change the positions of his batteries frequently, and to split up his batteries by sections when subjected to our concentrated counter-battery fire, has added considerably to the difficulty of keeping this counter-battery intelligence up to date. Records must include not only the actual positions of the enemy's guns, but also the nature of protection afforded. Much can be done to immobilise the enemy's artillery, when located, by destroying all exits from the position, and these, therefore, must also be studied. The chief sources of information are:

a. Air photographs.
b. Reports of R.F.C. observers (including balloons).
c. Observation Groups of the Army Field Survey Cos.
d. Sound Ranging Sections.
e. Reports from R.A. O.P.s.
f. Reports of hostile shelling.
g. Wireless intelligence.

All information of immediate importance must be forwarded direct to Headquarters, Corps Heavy Artillery and the C.B.S.O., who have to act on it. At the same time the closest touch must be maintained between the Counter-Battery and Artillery Reconnaissance officers and officers of the Intelligence Section of the General Staff, as well as the R.F.C. and Field Survey Companies, in collating all information concerning the enemy's artillery; any tendency to work in watertight compartments must be avoided. From the information so obtained and discussed at the periodical counter-battery conferences, the Active Hostile Battery Lists are compiled at the Headquarters of the Army or Counter-Battery Staff Office.

The frequency with which these conferences should be held will vary with the tactical situation and with the suitability of the weather for R.F.C. work. In periods of activity they should be held daily.

Good results can only be obtained by exploiting all the available sources of information to the fullest extent, and by the careful collation and minute study of the results of each. Each hostile battery when accurately located is allotted a number by the Army or Corps. These numbers consist of the zone letters (vide S.S. 131, para. 24) and a numeral, e.g., M X 12. An Army list and a map of hostile battery positions, with their numbers, are issued periodically.

13. Air Photography. — The system under which the front is photographed in the counter-battery area and behind is described in S.S. 131, Section III., 12. The study of the photographs is carried out both at the Squadrons and by the Artillery Offices concerned, and also by the Intelligence Branch of the General Staff. The results of their separate studies must be co-ordinated and expressed (so far as counter-battery work is concerned) in the details given in the Active Hostile Battery Lists.

Photography is the basis of good artillery work, especially of counter-battery work, and photographs must be very carefully studied for indications of new work and of fresh dispositions. Endeavours must always be made to verify on a photograph hostile battery positions located by other means.

In the first place photography is essential if no hostile battery is to escape punishment. It does not necessarily follow that a gun position is unoccupied because no flashes are seen to appear from it, while, on the other hand, both dummy flashes and blank charges may be used to simulate active batteries. Again, it must not be assumed that because a battery is known to have moved, or to have been destroyed, its old position will not be subsequently repaired and re-occupied, nor, on the other hand, that a battery will move because it has been severely handled.

Careful comparison of photographs of various dates will greatly assist decision as to whether emplacements are occupied or not, attention being particularly paid to the marks made by tracks and the blast of guns, and to the actual condition of the pits.

Air photographs will also disclose the position of emplacements constructed for the support of the enemy's rearward lines of defence, and will thus enable a Commander to work out in advance his arrangements for counter-battery work in the future. Constant photography of the areas likely to be occupied by hostile artillery is therefore called for at all times, in the hope that new positions may be detected in the first stages of their construction, before effective concealment has been obtained.

Finally, air photographs will assist a Commander to appreciate the extent to which his counter-battery work is crowned by definite results. It is of distinct advantage if aeroplane photographs of hostile batteries are taken before and after destructive shoots.

Photographs must be kept properly indexed in boxes or portfolios, so that any photograph can be turned up at a moment's notice.

14. Reports of R.F.C. Observers.—At least one machine should be up in every corps counter-battery area during the hours of daylight, whenever flying is possible, as an

artillery patrol to locate targets.

Even when low flying only is possible much useful work can be done by artillery patrols working from behind their own troops, especially in spotting flashes, which are often more easily seen on a dull day, and in reconnaissance of the enemy's trenches. Squadron Commanders must be kept fully informed by the Counter-Battery Staff Officer as to the latest information concerning their Corps and Flight areas. The duties of pilots and observers in locating and reporting hostile batteries are laid down in S.S. 131, Section X.

15. Reports of Balloon Observers.—Balloons can afford special assistance owing to the fact that they can combine aerial observation with good telephonic communication with the ground. Owing to their position they are suitably placed to observe hostile bombardments and barrage fire, and to report on their intensity and on the areas bombarded. They can sometimes, in addition, observe the connection between the flashes of the enemy's guns and the fall of their shell. Such information is of great value to the artillery during trench warfare, since it enables the arcs of fire of the enemy's batteries to be established approximately. This, in its turn, enables counter-battery fire to be directed on to the most likely hostile batteries when any particular area is subsequently bombarded by the enemy, or when general neutralization is required over a particular area.

Night observation from balloons should also give valuable results (vide S.S. 131, para. 60).

16. Observation Groups.—The Observation Groups of the Field Survey Company are charged with a general surveyance of their front; their most important duty is the location of the enemy's batteries by means of accurate intersection of flashes observed from the different Survey Posts. The extent to which these Groups are employed for ranging our own guns must depend on their development, and as to whether this duty or that of locating hostile batteries is the more important at the moment. This is a matter which must vary with the tactical situation, and therefore can only be decided by Armies. Ranging carried out by these Groups has been marked by a high standard of speed and accuracy.

17. Sound Ranging.—Improvements in "Sound Ranging" greatly facilitate the work of recording hostile batteries. Hitherto wind has interfered considerably with the accuracy of their results; with the improvements in methods and apparatus now being introduced the number of unreliable results should be very small. No results can be expected during a bombardment of any intensity, nor when a strong wind is blowing from our lines over the enemy's. By the collation of a number of "Sound Ranging" results it is possible gradually to work out the arcs of fire of hostile batteries, and knowledge of this nature will obviously much facilitate counter-battery work, especially during periods of trench warfare. By the same process "dummy flashes" regularly used by the enemy's batteries should gradually be discovered. (See S.S. 199 "Co-operation of Sound Ranging Sections and Observation Groups with Artillery.") Useful co-operation can be carried out with the R.F.C. if Sound Ranging Sections can be supplied with a Wireless Receiving Set. On seeing a flash, the air observer sends a pre-arranged signal to the Sound Ranging Section, who can at once set their apparatus in motion. This method is of special use when visibility is not good enough to enable a flash to be accurately pin-pointed. It is also of use for the detection of dummy

positions on days of good visibility when positions can be accurately located.

18. Royal Artillery Observation Posts.—The principal role of these posts is direction of fire, but where the ground is favourable to observation a considerable amount of location of hostile batteries should be effected by the R.A. O.P.s on the Corps front by means of cross-observations. This work requires considerable development. For it, Mark V. directors or similar instruments, properly oriented, are required in at least two O.P.s per Artillery Brigade for recording flashes. Such observation should always be transmitted to the Counter-Battery Staff Officer as quickly as possible, and be reported as so many degrees right or left of a clearly defined point from the O.P. (co-ordinates to be given), or as a grid line bearing. In order, however, to be quite certain that intersections are obtained on the same flash, some system of instantaneous communication between the two O.P.s or a co-ordinating central office is essential. Single bearings at a stated time are rarely of much value; if they are to be of any use, the synchronization of watches must be carefully attended to.

In every Brigade at least one O.P., in which a director can be used, should be manned continuously during the 24 hours.

The Brigade F.O.O. must keep a log-book containing all information of hostile activity.

19. Reports of Hostile Shelling.—In order to achieve prompt and effective neutralization, if not the immediate destruction, of a hostile battery which is causing material damage of any sort, it is most important that hostile fire should be reported as promptly as possible through the Artillery Brigade Commander concerned to the Counter-Battery Staff Officer. It is the duty of all units and of all branches of the service to do this. Officers are often inclined to think, when they see another battery or infantry trenches, etc., being shelled, that the unit concerned will have reported it if it is causing either annoyance or loss; it frequently occurs, however, that communications with the bombarded area are cut, and consequently a direct report cannot be furnished. In reporting cases of hostile shelling the following facts should be clearly stated, as far as known :

viii. Hour at which shelling began.
ix. Calibre and nature, and number of guns firing.
x. Area shelled (by map square, not by local name).
xi. Direction by grid bearing (of flash or of sound to be stated), or by bearing from some prominent landmark.
xii. Whether material damage is being done.
xiii. Hour at which shelling ceases and approximate number of rounds fired.

It is advisable that the counter-battery organization of every Corps should maintain a permanent look-out, night and day, to report direct to the Counter-Battery Staff Officer the occurrence and details of hostile shelling within their view.

Arrangements must be made for Counter-Battery Staff Officers to obtain these reports, not only from the infantry and other troops of their own Corps, but also from the troops of adjoining formations which hostile guns in his counter-battery area are wont to shell.

In order to draw the enemy's fire, various ruses may be employed. Practice barrages in conjunction with smoke shell will often prove successful; field guns employed as roving sections or single guns may draw fire; "Chinese" attacks, or even a vigorous display of trench mortar activity, are other methods. Generally speaking, however, infantry must take part in such demonstrations, as action by artillery alone cannot be guaranteed to achieve the desired effect.

20. Counter-Battery Instructions and Registers.—Every battery detailed for counter-battery work should have a file, in which all instructions relating to this work will be kept. In addition, a Target Book should be kept up, containing the following information regarding hostile batteries within their arc and range—namely, A.H.B. number, co-ordinates of the pit pre-arranged for registration by aeroplane, switch from zero line, angle of sight, range, charge, elevation reduced to normal, and remarks.

A complete record of all hostile battery positions will be kept up in the Counter-Battery Staff Office on A.F. W.3710, and air photographs should be arranged and indexed with reference to these sheets.

By this means it is possible to compile a list showing at a glance the positions and natures of hostile batteries that are known to fire on the various sectors of our line, while constant reference to this list and to the batteries' records will not only enable counter-battery fire to be directed from day to day on reasoned lines, but will build up a valuable store of knowledge on which to work in a battle.

Each Brigade will keep a record of daily activity of hostile batteries, showing measures taken to deal with them.

V. PRINCIPLES OF ACTION.

21. Characteristics of Counter-Battery Work.—The characteristics of counter-battery work are four-fold:

N. Destruction of the enemy's batteries.
O. Destruction of artillery personnel.
P. Fire to obstruct ammunition supply.
Q. Neutralization.

It is evident that destruction of the enemy's batteries offers the most satisfactory means of reducing his artillery to impotence. But since this ideal cannot be completely achieved, valuable results may be obtained by concentrating fire on battery positions, and even on areas occupied by batteries. Further, occasions will arise, both during active operations and when holding the line, when the infantry must be protected against hostile artillery fire by means of neutralization. The immediate object of all counter-battery work is to obtain maximum effect on the enemy's artillery, and therefore it cannot be too often repeated that batteries employed on this work must in principle be placed well forward, so that distant hostile batteries may be reached, and also that full benefit may be reaped from enfilade and cross fire.

A. Destruction.

22. Principles.—The howitzer is par excellence the counter-battery weapon for destructive purposes, owing to the advantages it possesses over the gun in accuracy and its ability to deliver its shell at very steep angles of descent. Destruction must be regarded as a continuous procedure, as already stated in a previous section, and is to be carried out at all times with relentless vigour, both during actual battles and in the intervals between them.

To ensure the destruction of a hostile battery, certain requirements must be met:

r. It must be established that the position to be engaged is actually occupied.
s. Fire must be carefully controlled and observed, not only during ranging, but also while firing for effect.
t. A sufficient quantity of ammunition must be devoted to the task in hand.

As regards (b), fire is only of value if it is accurate, and this depends on control and observation. Both guns and howitzers have a tendency to lose exact range or line to a target from a variety of causes, even though ranging may have been satisfactorily accomplished.

Fire must therefore be carefully controlled and observed, not only during ranging, but also while firing for effect, if destruction is to be definitely achieved.

During a destructive shoot with aeroplane observation, after ranging has been completed and fire for effect has begun, the fire of one gun of a battery should be withdrawn at a time and its fire checked on the nearest suitable datum point, and then once more turned on to the aeroplane target. If for any reason it is necessary to continue the series without any observation, the Battery Commander should cease firing on the target from time to time, range on a datum point, and make any necessary corrections before resuming fire for effect. Records of this procedure should be retained for reference in case of future unobserved shoots on the same target.

23. Ammunition.—Touching the expenditure of ammunition, it is useless to attempt the destruction of a hostile battery with a small number of rounds. As a general guide, it may be assumed that under ordinary conditions not less than the following number of rounds will be required to effect the complete destruction of a single well-protected gun pit:

Rounds.

6-inch Howitzer: 100
8-inch Howitzer: 80

9.2-inch Howitzer: 60

Figures for the 12-inch howitzer cannot be stated, as this weapon will usually only be used in conjunction with continuous aeroplane observation. Fire should, under these circumstances, be maintained until the observer is satisfied that the hostile battery has been destroyed.

When a battery position is engaged in enfilade and the pits are not far apart, the average number of rounds per pit can be considerably reduced. Economy of ammunition is to be sought, not in withholding any of the amount required for a legitimate task, but in taking every precaution to ensure accuracy of fire and by avoiding the possibility of waste, due either to the engagement of a doubtful target or to the adoption of a policy of half-measures. If a hostile battery is to be destroyed, then fire should not cease till the result, as far as it is possible to tell, has been achieved.

24. Importance of Saving Time.—Time is a factor of great importance in destructive work as regards the co-operation of the Royal Flying Corps, and every step that can be taken to expedite fire observed from the air is an emphatic gain.

This is particularly important during periods of preliminary bombardments, and also in the winter, when the hours of good flying weather and visibility are few; in both these cases every minute saved is valuable.

During active operations the number of machines that can work on a Corps front is limited (S.S. 131, paras. 7 and 37) and the number of hostile batteries which have to be engaged for destruction tends to increase. Rapidity in ranging and attention to ground strips are, therefore, essential; otherwise the observer's time is wasted, and fire for effect cannot be observed throughout.

With the slower firing howitzers the destruction of a hostile battery may be undertaken simultaneously by two or more batteries of the same group. Each battery is ranged in turn, and signalled to wait until all are ranged. Unless guns are well calibrated and shooting accurately much time will be lost by this method, as should the fire of one battery become inaccurate it will be necessary to stop the fire of each in turn to discover which is off the target and to range it afresh. Normally, however, destructive effect is, under present conditions, best assured by concentrating all the guns or howitzers of a battery on each emplacement of the hostile battery in turn; the order in which the emplacements are engaged being arranged beforehand.

25. Programmes and Observation of Fire.—Known batteries must be definitely selected for an attack in order of their importance and activity, both before and during active operations, and be notified in the daily programme of counter-battery work. This programme must be drawn up and issued each evening. Details as to its contents are given in S.S. 131, para. 16 (c).

It is essential that these programmes should be submitted to the Corps Squadron as early as possible each evening. To obtain the greatest effect from aeroplane co-operation, shoots should commence at the earliest possible moment of the day. Aeroplanes cannot be detailed for the following day's work until the programmes are received by the Squadrons. After this pilots must have ample time, if the best results are to be achieved, to study all available photographs of the hostile batteries to be engaged, in addition to reading up the past history of the batteries, studying the position of ground strips, the position of our own batteries, etc.

Pre-arranged shoots should be carried out as systematically as possible so as to admit of the maximum amount of aerial observation of fire for destruction. Fire for destruction with aeroplane observation should, when possible, be followed from two ground observing stations, the observers being informed when the aeroplane observer gives "O.K." This procedure may assist to secure accurate fire at some future date when no aeroplane is available.

Aeroplane observation should, however, invariably be provided, if the tactical situation admits, in the case of fire for destruction when accurate observation from the ground is impossible. Time, however, can often be saved by combining aeroplane and balloon observation (see S.S. 131, para. 59 (b)).

Whenever an observer signals that he is ceasing to observe a report should at once be made to the C.B.S.O., stating the number of rounds fired, whether the battery has been successfully ranged, and if a balloon has signified its ability to observe for the remainder of the series. The C.B.S.O. can then, if necessary, arrange for another aeroplane to complete the shoot, for balloon observation, or direct the battery to fire the allotted number of rounds without observation.

26. Choice of Weapons to be Employed.—Consideration must always be directed towards the selection of the most suitable weapon for destructive work in each instance. Apart from the question of oblique fire, which has already been touched upon, it is obvious that the heaviest howitzer should preferably be employed when the protection of the target is known or reasonably believed to be of the strongest. Similarly, against a battery unprotected or merely camouflaged, the field howitzer may prove a perfectly adequate weapon.

Commanders should bear in mind that at times of abnormal artillery movement, such as must occur in the case of a hurried reinforcement on a large scale, or of a sudden retreat, there will be periods during which a number of hostile batteries will be little if at all protected. Under such circum-stances full use can be made of the lighter forms of artillery for counter-battery work, so long as the protected and unprotected targets can be distinguished.

27. Concentration Shoots.—The principle of concentration of the fire of several batteries against the enemy's batteries, or rather battery positions, has recently been adopted by us, both as a means of adding to the results to be expected of observed destructive fire, and as the only procedure possible when weather conditions have denied or seriously limited the

artillery work of aircraft. This method of fire has been taken up by the enemy, and has on many occasions proved a source of material annoyance. Its practice, therefore, on intelligent and controlled lines is worthy of exploitation, so long as it is never suffered to over-ride the prior claims of observed fire for the deliberate destruction of individual hostile batteries.

A fierce concentrated fire from as many batteries as can be made available should achieve good effect on ammunition pits in rear of or to the flanks of the position, battery command posts and signal communications; indeed, the general result should be to so cut up the ground as to render that position useless for further occupation.

Fire of this nature may be divided into two main categories:

u. Concentration shoots with aeroplane observation. This form of artillery attack may undoubtedly prove very effective, but generally speaking it is only justifiable when time is short, our aeroplanes limited in numbers, our batteries numerous, and the target an exceptionally important one.
v. Concentration shoots without observation. This form of attack may be further sub-divided into:
    i. Fire for neutralization. A concentration of artillery fire will prove a most effective form of neutralization, particularly if our batteries are well dispersed. (See. para. 33.)
    ii. Fire for destruction.

Provided that guns can first be ranged and corrected on a good datum point, with approximately the same range and line as the target, good results may be expected. The most successful concentration shoots have been effected during the afternoon by batteries which have been accurately ranged during the morning of the same day on targets situated in the area selected for concentrated attack.

At the same time it must be remembered that fire delivered on this principle becomes less likely to be effective as the course of a battle lengthens. With deteriorating platforms, salvaged or un-lotted ammunition, and tired detachments, or when, after an advance, accurate battery boards are for the time being not available, it cannot be expected that this method of fire will attain results commensurate with the ammunition and energy expended.

The best chance of success will often lie in directing the fire of several batteries against the furthest hostile battery of three or four close together. Experience shows that fire at long ranges tends to be short rather than over, particularly when guns and ammunition are not in the best condition. Thus, fire aimed at the most distant battery of a group may under these conditions obtain effect on the others. A single concentration of fire may be carried out with, say, 150 rounds per battery employed; or in two or three shoots at intervals during the day, with a proportionately decreased expenditure for each series. Occasionally a whole nest of hostile batteries may be known to be collected within a limited space, for instance, in a village or small wood; in such cases it may prove well worth while to carry out a concentration shoot on a large scale, employing every available battery, with the object of blotting out the whole of the guns assembled in the area.

B.—Destruction of Artillery Personnel.

28. A destructive shoot carried out on a battery at a time when the detachments are bound to remain at their guns will, if accurate, automatically result in casualties to personnel.

But at other times, when the situation admits of the detachments of a shelled battery being withdrawn, satisfactory effect upon personnel can only be obtained by surprise and, even so, only for a short period.

It is with this object that it has been laid down (S.S. 131, Section VII., 31) that all counter-battery shoots should commence with two salvos fired in rapid succession and with instantaneous fuze. Short, sharp concentrations of fire on hostile batteries, particularly if active at the moment, may achieve good results on the gun detachments before they can be withdrawn.

Shrapnel or H.E. fire with No. 106 fuze may be employed with advantage at night, after a successful destructive shoot, in bursts at irregular intervals, with the object of inflicting loss on personnel and horses sent up to move the damaged battery. Fire of this nature must not be allowed to die down during the early hours of the morning.

Again, the moment that a destructive shoot has been successfully completed, and so before atmospheric conditions have altered, a salvo (with No. 106 fuze) may be fired at one or two neighbouring hostile batteries or other likely targets, with the object of inflicting casualties on any spectators. Occasional rounds placed well to the flanks and rear of a hostile battery undergoing destructive fire have been known to do useful execution on personnel.

Other surprises of this nature should be thought out and applied, but anything in the nature of a hard and fast procedure is to be avoided, or else the enemy will soon learn what to expect and act accordingly. This last consideration may also be turned to advantage if some minor scheme can be adopted for a few days, and then be suddenly and advantageously altered.

C.—Fire to Obstruct Ammunition Supply.

29. Material results may accrue from deliberate attempts to destroy, or at least to block, roads, railways, tramways and bridges, which reconnaissance and intelligence records show as likely to be used by the enemy for supplying ammunition to his batteries.

To what extent destruction can be undertaken must depend on tactical requirements. The obstacles that may be created by the effect on roads, etc., of heavy shells fitted with delay action fuzes must be fully considered when an advance by our own troops is intended. But where this consideration does not apply, experience shows that the constant cutting of ammunition routes by shell fire proves a serious handicap to the opposing artillery. Under all conditions the enemy's system of supply to his batteries may be rendered hazardous and costly by means of harassing fire, intelligently directed and frequently varied in its application. (See Artillery Notes No. 4, Section V., "Fire to effect physical and moral damage."

D.—Neutralization.

30. Object.—Neutralization is a temporary expedient designed to paralyse and blind by a sudden and violent application of fire those hostile batteries which have not been destroyed. It will therefore be required in both offence and defence. It is normally the task of medium guns and howitzers, assisted by Divisional Artillery, when available. Heavy howitzers may also be usefully employed on occasion.

31. Application.—In the offensive, directly the infantry leave their trenches they must be relieved as far as possible of the burden of the enemy's barrage, which may otherwise inflict considerable losses, and even arrest their movement.

At this moment fire must be opened on every hostile battery, known or suspected, of a sufficient intensity to prevent the service of the guns. By cutting the batteries' communications and by engaging all known observing stations the power of the hostile artillery will be still further reduced. The necessary neutralization scheme must, of course, be prearranged. If flying is possible, all active hostile batteries will be reported under the NF (or WPNF) and those ceasing to fire under the NT call (see S.S. 131, para. 29 (i.) (b)), so that fire can gradually be concentrated on those batteries which are actually firing.

After the attack every effort must be made to resume pre-arranged shoots as early as possible, "MQNF" and "ANF" calls being employed to supplement the work. New counter-battery areas must be allotted at once and notified to all without delay, where in the case of a limited objective it has not been possible to do this beforehand.

32. In cases of preparation by the enemy for attack or counter-attack, and at other times when he subjects our infantry to a severe bombardment, the need of neutralizing fire will occur just as much as at the moment of our own assault. The infantry again must be relieved of the weight of the enemy's fire, and under such circumstances relief can only be immediately effected by a general neutralizing fire, which must for the time being take precedence over the pre-arranged destructive programme of the day.

33. In all schemes, therefore, of offence and defence, regard must be had to the orders and arrangements necessary to produce effective neutralization, either at a pre-determined hour or at a moment's notice, as the case may be.

Neutralization schemes must always be kept up to date, varying in their details from day to day, in accordance with changes in the disposition of the hostile artillery. Advantage should be taken, whenever possible, of cross-fire, and the concentration of widely dispersed sections or batteries is likely to give the best results.

34. Neutralization zones must be allotted to groups and batteries (see S.S. 131, para. 28

(i.)), and, in considering action to meet attack or counter-attack by the enemy, the counter-battery programme must include a scheme of general neutralization to be executed, if required, by every available gun that can be spared for the purpose. (But see Section VII.)

35. Neutralizing fire must always be brought to bear as rapidly as possible, apart, of course, from occasions when it is opened simultaneously by a number of batteries at a pre-arranged hour. During periods of activity fire for effect will often have to be undertaken from the map without any previous ranging and without observation. If observation is available, rapid fire should be opened as soon as range and line have been obtained. Fire should be distributed over the whole target from the first round.

36. The essence of neutralizing fire is not only to silence, but to keep silent, a hostile battery which has not been destroyed. Methods of neutralizing fire should therefore be constantly varied (notably as to the number of rounds and rate of fire), so that the enemy may never know what to expect.

A stereotyped scheme whereby a given number of rounds is always fired in a given time will soon prove ineffectual, for it is of little use neutralizing a hostile battery if the personnel realise that fire will always cease after so many rounds or so many minutes.

37. Gas Shell.—Gas shell are particularly valuable in counter-battery work for neutralizing hostile batteries immediately prior to and during an attack, and should be employed in large quantities for this purpose. Recent experience has shown that this procedure has been attended with very excellent results, some hostile batteries so neutralized having subsequently remained silent for two or three days.

Another useful method of employing gas shell is to shell certain batteries persistently with gas night after night. A sufficient expenditure of gas shell to compel the enemy's gunners to wear their masks all night will gradually produce physical exhaustion from want of sleep.

The method of conducting gas shell bombardments is laid down in S.S. 134 (Instructions on the Use of Lethal and Lachrymatory Shell), which must be carefully studied.

38. Co-operation of E.F.C. and A.A. Guns.—The Royal Flying Corps play a direct and important part in neutralization. For while the enemy's ground observing stations and occasionally his balloons are the charge of the artillery, his aeroplanes and the majority of his balloons must be engaged by the Royal Flying Corps, who thus assist to deprive him of his means of observation.

Anti-aircraft guns must also take a vigorous share in denying to the enemy the benefits of aerial observation. Similarly, to assist the R.F.C., vigorous artillery action must be taken against the enemy's anti-aircraft batteries.

39. A thorough and detailed scheme is therefore essential to effective neutralization, and such a scheme can only be built upon knowledge. Hostile batteries will not be neutralized

unless their whole history is studied from day to day with untiring energy. Further, to increase the chances of success, measures must be taken to arrange as far as possible for observation from the air and from the ground of the fire of neutralizing batteries.

40. Ammunition.—The expenditure of ammunition in neutralizing shoots depends largely on the tactical situation at the time and on the artillery resources available. Instructions on this subject must therefore be laid down from time to time by Armies and Corps. Uncontrolled expenditure of ammunition on neutralization undoubtedly leads to great waste. As a general guide, 10 to 30 rounds should suffice for an ordinary neutralizing shoot when holding the line.

VI. COUNTER-BATTERY WORK IN THE OFFENSIVE.

41. The Artillery Plan.—The counter-battery scheme forms a definite part of the Artillery Plan. As stated in Section I., counter-battery work is a continuous procedure, and therefore the counter-battery scheme should at all times be readily and easily extended so as to embrace the requirements of active operations. For the latter purpose three main factors have to be considered, apart from the general plan of operations:

xxiii. The hostile artillery. Its disposition, quantity and nature; the probability of increase thereto prior to "Attack Day" (a matter directly affected by the General Plan and by the length and scope of the preparations), and the areas in which reinforcements are most likely to be disposed; the enemy's artillery tactics.
xxiv. The amount and natures of artillery required and the siting of it, based on the two foregoing considerations.
xxv. The extension and improvement of all available means of observation, reconnaissance, and communication.

42. The Hostile Artillery.—As regards the disposition of the enemy's artillery, certain tendencies have frequently been remarked, and require consideration at the hands of commanders when framing the counter-battery portion of their Artillery plan.

z. When offensive operations by us have been anticipated, the enemy has on several occasions established a large force of artillery on the flanks of the front of attack.

This procedure affords the enemy the ability to concentrate a powerful fire on our artillery behind the centre of the attack, and at the same time confers on him the advantages to be derived from cross-fire. It entails on our part special attention to counter-battery work on the flanks, and so directly affects the allotment and siting of counter-batteries.

A particular problem is presented where our attack is launched from a salient of moderate size (about 5,000—7,000 yards radius), such that the enemy's medium-range artillery can reach the centre of the salient from several directions.

In this case some of the hostile batteries grouped round the salient will be in the normal counter-battery area of Corps on the flanks of the salient, but out of range of their counter-batteries.

In these circumstances it has been found advantageous to detach a counter-battery group towards the centre of the salient rather than to require the centre Corps to undertake the duty of engaging these distant hostile batteries. The disadvantages of long transverse telephone lines will be more than compensated for by the ability to direct fire against troublesome hostile batteries under the usual Corps arrangements. It will also facilitate the collection of shelling reports relating to hostile batteries on the flank that habitually shoot into the centre of the salient. At all times there must be considerable elasticity in the dividing line of Corps counter-battery areas.

aa. The occupation of positions by hostile artillery so far behind their front line as to be out of reach of the mass of our counter-batteries, but yet able to shell our infantry and the general line of our field batteries, has frequently occurred. This tendency has been generally observed after a successful assault has brought about a modification in the enemy's original scheme of artillery defence, though certain batteries may be held back in such positions from the time that an attack by us is contemplated.

To compete with this problem two main principles must be followed. Firstly, rearward enemy positions must be sought for studiously by means of air photographs (see Section IV. 13), both before and during offensive operations. Secondly, on all occasions and at all stages of an attack sufficient counter-batteries must be placed well forward, so as to be ready to deal with the enemy's distant batteries, either at once, if such already exist, or when they come into being later.

Counter-batteries, therefore, should have priority among Corps Heavy Artillery in the choice of forward positions, and, when circumstances admit, masked counter-batteries may advantageously be placed in position prior to an assault, with the above object. Long-range pattern howitzers are obviously to be preferred for counter-battery work, and if artillery of this type can be placed well forward a material advantage is gained.

bb. The increasing use of alternative positions by the enemy's batteries, the employment of sections and single guns, the occupation of temporary and unprotected positions in hedge-rows, etc., the system of running forward field batteries for night-firing (especially for gas shelling), and the employment of mobile batteries in the support of counter-attacks, are other developments against which our counter-battery methods have to contend.

The best hope of success in these directions lies in the tireless employment of every available means of counter-battery reconnaissance (see, Section IV.), particularly by night, and in co-operation with Intelligence as regards roads, tracks, etc., likely to be employed for the movement of artillery.

Beyond this, it may prove best to base counter-battery programmes on the NF calls received during the early part of the day, and to carry out destructive shoots the same afternoon, or, at latest, early the following morning. Full use should be made of the M.Q.N.F. call under these conditions.

43. The Support of the Attack.—With the mass of artillery that is usually available to support the infantry in offensive operations on a grand scale, the quantity of artillery to be allotted to counter-battery work after the assault has been successfully launched needs to be very carefully considered; for it is evident that the more guns that are devoted to this task, the fewer remain available for barrage work.

Experiences show that, in the case of our attacks on a large scale, the enemy's artillery is rarely dangerous except:

cc. While our Infantry are forming up, if our intention to attack is known or suspected, at "Zero" hour and for a short time afterwards.
dd. During prolonged halts on intermediate objectives.
ee. During the early stages of consolidation.

It appears, therefore, that, with the present strength of artillery and assuming the previous counter-battery work to have been effective, a large proportion of counter-batteries may be devoted for a time with advantage to strengthening the depth and power of the barrage, as soon as the assault shall have been successfully launched. The situation must, however, be closely watched. If the enemy's artillery becomes a serious factor, either to our infantry or to our guns, it must be possible to turn on an adequate force of artillery to take up counter-battery work again without delay. To this end arrangements should be made, if the ground is suitable, for a counter-battery observing station to be established, from which an intermediate or the final objective can be seen. An experienced officer should be detailed to occupy it. He will be able to see if the enemy's fire becomes troublesome, and must be held responsible for recommending that the application of an increased number of batteries to counter-battery work is necessary.

44. Allotment of Aeroplanes to Counter-Battery Work.—The considerations affecting the allotment of aeroplanes to the various natures of artillery work are fully discussed in S.S. 131.

It must always be remembered that the number of aeroplanes that can work at the same time on a Corps front is limited by the length of the front and the strength of the squadron. The practical extent of these limitations is explained in S.S. 131 (paras. 7 and 37).

45. The Attack of Hostile Batteries located just prior to an Attack.—It is open to question whether hostile batteries definitely located just prior to an attack should be destroyed at once or not. Every battery that is destroyed is one less to reckon with on the day of attack. On the other hand, batteries that are severely shelled, and not actually destroyed, may be

induced to move to a new position, and so be unlocated at the hour of assault. In this case it may be impossible either to destroy or even to neutralize them at the critical moment. These considerations must receive due weight in the artillery plan for an offensive operation.

VII. COUNTER-BATTERY WORK IN THE ADVANCE.

46. The maintenance of systematic counter-battery work during an advance is a matter of the utmost importance; and the more rapid the advance, the more difficult will it be to keep touch with the hostile artillery dispositions. The infantry must be protected from the enemy's fire, and this can only be accomplished by most carefully organized action on the part of the artillery primarily responsible for counter-battery work, by the closest co-operation between R.A. and R.F.C., and by untiring energy in the services charged with the locating of hostile artillery.

Continuity of effective counter-battery work depends primarily on the fulfilment of four main conditions :

ff. A prepared and systematic scheme of artillery movement.
gg. Ability to maintain an adequate ammunition supply to batteries detailed to advance.
hh. The fullest exploitation of the zone call system, supported by all other means, applicable to the situation, of locating hostile batteries.
ii. A carefully co-ordinated and detailed scheme for the forward movement of Observation Groups and Sound Ranging Sections.

The first two conditions affect all artillery, whatever its tasks may be, and are discussed in detail in Artillery Notes No. 4. But it is of particular importance as regards counter-battery work to ensure that a sufficient number of counter-batteries are placed well forward prior to the original assault (see Section VI., 42 (b)) in order that it may be possible to continue effective counter-battery work without a break while more retired batteries are advancing. In the earlier stages of an advance, before the situation has begun to assume the character of open warfare, the normal counter-battery system will still hold good in most respects. Sound Ranging Sections will not, however, be able to carry out their normal functions until a pause occurs in the operations; and Observation Groups will scarcely be able to co-operate with the artillery, so long as a steady advance continues.

The forward movement of these units must, however, be expedited to the utmost, in order that they may resume their functions with the least possible delay at the first pause in the advance.

The burden of finding the enemy's batteries will therefore fall on the Royal Artillery and Royal Flying Corps, who must combine their efforts in the closest possible touch. It is for this reason that the zone call system must be exploited to the utmost. Success will very largely depend on the rapidity with which wireless receiving stations are brought into action and also on having a definite scheme of responsibility, pre-arranged and universally understood, for answering zone calls over specified areas. Whenever circumstances permit, it will be found best to detail one or two batteries to reply in the first instance to calls from such areas. At the same time Artillery Brigade Commanders must take in all zone calls at their masts in order to keep touch with the situation and bring additional fire to bear when required.

In the early stages of a rapid advance the Field Artillery must be prepared to take up a greatly increased share of counter-battery work. Such R.G.A. Brigades as have moved forward and can no longer be controlled by the Corps Heavy Artillery Commander will be placed under the orders of Divisional C.R.A.s, who will then be responsible for the direction of counter-battery work.

The Corps Heavy Artillery Commander must, however, keep in close touch with the situation, so that he may resume tactical control of all the heavy artillery under the Corps at the first possible moment.

As more artillery comes up it is essential that definite areas of responsibility for dealing with zone calls shall be allotted to batteries, and new counter-battery areas delimited and notified to all concerned without delay. The extent to which the hostile artillery can be engaged by zone call and with aerial observation will be limited, even under the most favourable circumstances, and the eyes of the Battery Commander must be exploited to the utmost. The artillery must not rest content with merely firing unobserved series in answer to "NF" calls, but must endeavour to destroy the enemy's batteries whenever and however located.

A rapid advance will throw the organization of the C.B.S.O.'s office temporarily out of gear. He must take every precaution not to lose touch with the enemy's artillery dispositions. For this purpose, as soon as a state of open warfare develops, he and his staff will join Corps Headquarters. He will there be best able to collect all the information that is available regarding the hostile artillery. The G.O.C. R.A. of the Corps must then arrange that this information is disseminated among the artillery formations supporting the advanced troops, and that information is in turn collected from them. As soon as a marked pause in the operations occurs, the counter-battery office should be quickly re-established in the forward area and counter-battery work resumed on normal lines.

VIII. COUNTER-BATTERY WORK IN THE DEFENSIVE.

47. As a matter of general principle, notification of a marked increase in the activity of the enemy's artillery should immediately be made to Corps Squadrons so that additional aeroplanes may be sent up to report which of the hostile batteries are active.

From a counter-battery point of view, however, the defensive may assume three forms:

jj. The defensive-offensive, or a defensive attitude temporarily imposed by a threatened or actual counter-attack during offensive operations.

kk. The conditions existing when holding the line and opposed by an approximately equal artillery. The action to be taken in the face of raids by the enemy is included under this heading.
ll. The true defensive, in the face of a numerically much superior hostile artillery.

48. Counter-battery Work to Meet Counter-Attack.—In considering the counter-battery action suitable for meeting a hostile counter-attack, it may be assumed that our original attack has been delivered with a force of artillery at least as strong as the enemy, and usually superior in morale. Consequently a counter-battery duel can be entered on with good prospects of success, always bearing in mind the principle that the target most dangerous to the infantry at the moment must receive first consideration. In the event then of a heavy bombardment being initiated by the enemy of sufficient intensity to betoken the threat of a hostile counter-attack, vigorous counter-battery work must be at once taken up.

The enemy's preparation may last for a few hours, or it may endure for several days. In the first case counter-preparation, as far as counter-battery work is concerned, will at the outset have to consist almost entirely of heavy neutralizing fire, though every advantage must be taken of the zone call system to correct the fire and to pass gradually to destructive shoots. In the latter case, more opportunity exists for deliberate destruction of the enemy's batteries, and neutralizing fire should take the form of powerful concentrations of artillery fire. Gas shell bombardments may be employed advantageously on such occasions.

Should the enemy advance to the attack, his infantry becomes for the time the most important target. As soon as the "S.O.S." signal is made, fire must be opened at once on the targets arranged as "S.O.S. Lines." The fire of the majority, if not all, of the counter-batteries should be super-imposed on that of bombardment batteries in order that an annihilating fire may be brought to bear upon the infantry of the counter-attack and their reserves.

As soon as the situation admits, the fire of the counter-batteries should be devoted again to their particular task. It is evident that a clear distinction must be made between the action of the artillery during the hostile artillery preparation and its action at the moment when an actual attack by the enemy's infantry takes place, or at least appears imminent. Artillery instructions must be drawn up beforehand, distinctly indicating the tasks to be undertaken by the artillery in the various phases of counter-preparation. S.O.S. Lines to meet these conditions, that is to say, lines laid out on the enemy's batteries and others designed to bring a devastating fire against his infantry, are therefore just as necessary for counter-batteries as for artillery devoted primarily to other tasks.

49. Counter-Battery Work when Holding the Line.—Counter-battery work under these conditions follows the general principles laid down in this book. The location of the enemy's batteries must always be pursued with the greatest energy, and their destruction be undertaken to the fullest extent that resources and weather conditions admit. The spirit of counter-battery work should be based on the principle that at some future time an offensive may be planned for the particular front, or even that a defensive attitude may be imposed by the enemy. Therefore every item of knowledge concerning the hostile artillery will be of

value and every battery destroyed a point gained, when and if active operations develop.

Neutralization will be called for in the daily routine, when, for instance, the infantry are being troubled by artillery fire or material damage is being done to defences. The morale of a hostile battery may be considerably affected by the knowledge that it will be subjected to prompt and accurate neutralization whenever it opens fire. But it must be clearly understood that spasmodic neutralizing fire is wasteful of ammunition, as it is unlikely to achieve good results; ammunition is far better expended in destructive shoots.

It is therefore important that hostile batteries should be quickly engaged not only when their flashes are seen from aeroplanes, balloons or observing stations, but also when their activity is deduced from current reports. Such deductions should frequently prove correct if the records of hostile batteries are carefully kept on the lines laid down in Section IV., and if a quick and reliable system of transmitting reports of hostile artillery activity exists.

50. Raids.—The action of counter-battery work in support of raids naturally follows the principles adopted in larger operations to the extent required.

Trench raids by the enemy, however, present certain features for consideration. The artillery support of a raid generally consists of a local barrage of the "box" type, possibly preceded or accompanied by a feint barrage elsewhere; the strength of the attacking force is usually small and should be adequately dealt with by the field artillery of the sector. If the enemy's barrage can be materially checked, the infantry will be in a far better position to repel the attempted raid by their own weapons. These circumstances, therefore, indicate that the enemy's batteries should be neutralized as promptly as possible, to which end counter-battery "night-lines" should usually be laid out on those hostile batteries which are most likely to be used as barrage batteries to support a raid.

51. Counter-Battery Work in the Defence.—As soon as prepara-tions by the enemy for an attack on a large scale are suspected, the counter-battery work of the defence must exhibit the utmost vigour on the general principles of counter-preparation. But if it becomes apparent that the numerical superiority of the enemy's artillery is such that the counter-battery duel must inevitably turn to his advantage, the action of the defending artillery must be carefully considered. The vital condition is that at the moment when the enemy's attack is launched, a prompt, accurate and adequate artillery fire shall be brought to bear on his infantry.

If the defending artillery has been materially reduced in power during the course of an unequal counter-battery struggle, it will not be able to fulfil its mission at the moment of assault, and the infantry will be deprived of that support to which they are entitled and to which they look. In such circumstances, the counter-battery work of the defenders may have to be severely curtailed; not that the artillery may merely avoid certain and severe losses, but in order that it may still retain power to shield the infantry at the decisive moment. The principles already stated in para. 47 hold good in this case also as regards meeting the enemy's actual attack, but with the additional proviso that the fire of every available gun, including those of all the counter-batteries, should be turned on to the hostile infantry.

Various points in connection with the action of the enemy's artillery on the defensive have been remarked in Section VI., 42, and these should receive consideration.

A material reinforcement to the artillery of the defence would naturally change the whole situation, and therefore need not be discussed here.

So long as the mastery of the air has not been gained by the enemy, opportunities for observed destructive fire will be presented under all conditions, and full advantage of them should be taken. The defending aircraft, too, will be able to indicate which groups of hostile batteries are most persistently active, and they can be selected for periodical and special attention in the form of concentrated neutralizing fire. But if the aircraft of the defence are placed at a disadvantage by the enemy's aeroplanes, the probability of effective counter-battery work on the part of the defending artillery will be very materially reduced. Under these conditions the enemy's artillery superiority may be best countered by a judicious use of alternative positions, by fire to destroy the dumps, railways, roads and tracks by which the enemy's batteries are fed, and by strong concentrations of gas shell at opportune moments.

It is evident that the combined concealment and strengthening of battery positions, and of observing posts, will do much to make it possible for batteries to live and to fire effectively in the face of a superior artillery. But this work must have been undertaken and constantly pursued long before the development of the expected attack; it cannot be improvised at the eleventh hour.

IX. MISCELLANEOUS.

52. The engagement of long-range guns on railway mountings.— The enemy's long-range guns on railway mountings have recently proved a source of material annoyance. The general plan adopted for the employment of these guns is to bring them up to different sidings on his railway system, to fire a few rounds and then to cease fire. A careful study of the enemy's railway developments will often disclose the arrival of a hostile heavy gun before it opens fire, and enable counter-measures to be taken. All gun sidings should be accurately located.

The lives and capabilities of British long-range railway guns are not favourable to their employment as regular counter-battery weapons. A duel between long-range railway guns is unlikely to achieve material results, except possibly at very great cost, and therefore the actual destruction of such hostile guns will seldom prove practicable. The following methods may, however, be tried against those that lie beyond the reach of our 6-inch guns.

As soon as a hostile long-range gun is located, it should be engaged at the earliest opportunity.

mm. In clear weather, arrangements should at once be made to bomb the target from the air and to engage it with our long-range guns assisted by aerial observation. A limited number of rounds only should be fired.

nn. In dull weather or by night, ranging by cross-observa-tion may be feasible or sound ranging may prove of value, if the wind is favourable.

oo. If no corrections can be obtained, a few rounds may be fired by means of calculations worked from the map, atmospheric conditions, etc., provided that the target has been accurately located.

pp. It may in some cases be possible to hamper the movements of the gun by the destruction of the railway bridges over which it has to pass.

53. Wireless—Responsibility of Artillery Commanders.—The following paragraphs, which are reprinted from S.S. 131, "Co-operation of Aircraft with Artillery," December 1917 edition, define the responsibility of Artillery Commanders as regards wireless personnel and material attached to their units : "They must ensure:

qq. That adequate care is taken of the instruments, especially when on the move. The complete station should always be packed in the carrying bags provided for the purpose. Strapped firmly on the top of a limber, wireless instruments can be taken over rough country without injury.

rr. That suitable cover is provided for the operators. It must be as soundproof as possible, and not too near the guns. A blanket must be provided to cover the entrance of the dug-out for use in case of a gas attack, and operators must be instructed in the best means of protection against gas, including the fitting of gas masks. The operator can be in the same dug-out as the battery commander, provided it is on high ground and not too close to the battery. Otherwise he must be provided with a separate dug-out and connected by telephone with the battery commander.

ss. That one operator is always on duty whenever there is any possibility of a machine working with his station.

tt. That the operators are informed by the unit with which they are working as to what calls they are to take, and notified of any changes.

uu. The wireless receiving sets and their operators must accompany the 'firing battery' in any movement during operations, and will invariably move with the unit to which they are attached on its transfer to another formation or area. Batteries and Headquarters provided with motor transport will convey the instruments and operators on the battery or headquarter vehicles. Field and horse-drawn Heavy Batteries must arrange for their conveyance on the vehicles accompanying the firing battery.

vv. Two operators are required for each ground set (one only in the case of the heaviest natures of artillery). Their sole duty is the reception of wireless messages.

ww. A man must be detailed by the artillery unit concerned to work the ground signals; the wireless operator is fully occupied.

Unless these instructions are loyally observed, failures are sure to occur, or trouble to arise, when any movement of artillery takes place."

54. Calibration and Datum Points.—Much time will be saved if guns are kept carefully calibrated and checked on datum points. Calibration is a matter of the greatest importance. (See G.H.Q. Artillery Circulars No. 3 and No. 4.) Every observed shoot, wherein guns have been ranged successfully, should be utilized for the purpose of checking calibration. If the terrain affords no point on which really good ground observation can be obtained, the guns can be ranged on any well-defined mark by an aeroplane or balloon before the shoot commences. Every battery should have a number of datum points within its arc of fire, at suitable ranges for counter-battery work. Other datum points should be selected by the Royal Flying Corps, so that batteries can be ranged on such points on days when visibility is too bad to admit of observation of destructive shoots. These points should be as far distant as possible. A datum shoot should always be carried out, if possible, before engaging a target without observation; for, unless this is done, fire will probably be ineffective. All batteries should therefore fire a few rounds on a suitable datum point daily, when weather conditions admit

32: SS139/7, Artillery Notes Number 7, "Artillery in Defensive Operations," February 1918

Source: IWM SS/CDS Pamphlets collection

By the General Staff
February, 1918

I. Principles of Defense in Relation to Artillery
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I.—PRINCIPLES OF DEFENCE IN RELATION TO ARTILLERY.

In all offensive operations the whole duty of the artillery is to prepare the way for and support the infantry with whom the eventual decision rests. On the other hand artillery must be regarded as the strongest weapon of the defence. For it alone is able to achieve serious effect on the enemy's troops at all times, to hinder or even to stifle his preparations and to effect decisive results by shell fire on masses of the enemy's infantry assembled for or launched to the attack.

These considerations define the role of artillery in defensive operations as under:

a. The systematic destruction of the enemy's fighting power (batteries, columns on the march, infantry defences and their garrisons, trench mortars, observing posts, etc.).
b. The bombardment of communications in rear (railways, billets, roads, dumps, etc.) and harassing all movement and work in the enemy's trenches.
c. The repulse of assaults (Annihilating and Barrage Fire).
d. The support of counter-attacks.

One of the essential considerations in the selection of positions for defence is therefore the relative advantages for the action of the defender's and of the enemy's artillery.

Good ground observation and covered positions for the artillery at favourable ranges should always be looked for, and conversely every endeavour should be made to render the position of the enemy in these respects as unfavourable as possible.

The particular missions demanded of the Artillery can only be satisfactorily met if the whole artillery organization of the defence is based on the principles of depth, suppleness and mobility.

Frequent movement to alternative positions is the best means of diminishing the effect of heavy systematic shelling during the preparatory period.

Once the enemy's attack is launched, rigid and purely defensive fire is not alone sufficient to arrest the progress of determined troops advancing on a wide front and to drive them back. Mobile artillery reserves, on the other hand, will prove of the greatest value, for their existence not only denotes a maintenance of the offensive spirit, but also enables a great variety of tasks to be undertaken at short notice. In the main they will be employed with most conspicuous success at places where the enemy has broken into our positions on a fairly extensive front, either by engaging specially favourable targets, or in supporting our attacks. Under certain circum-stances they can be utilized to reinforce the artillery already in line, or to fill gaps which may have originated during the battle.

The successful employment of artillery held in mobile reserve demands thorough preparation; this includes a careful reconnaissance of the whole battlefield as regards the possibilities of movement and most especially of observation, and also well-considered measures for the rapid supply of ammunition. The sudden intervention in the battle by well and boldly handled mobile artillery will always offer chances of far-reaching success. To effect surprise, however, skilful leadership and use of the ground are essential, and these points must receive particular attention in all artillery training.

II.—ORGANIZATION AND COMMAND.

2. The organization and chain of artillery command are explained in detail in Artillery Notes, Nos. 3 and 4.

e. "A Commander directs and supervises the action of his artillery through the medium of his Artillery Commander, who must be equipped with the authority, information and technical knowledge essential to his position. The Army deals with the distribution and employment of the artillery allotted to it, and with the details of artillery co-operation with Armies on either flank." It provides for co-operation between the various Corps, lays down the general principles to be followed as regards the various preparatory arrangements and the artillery action to be adopted both in routine firing and in the various phases of counter-preparation, and indicates the most effective measures to be employed in the defensive battle.

The G.O.C., R.A. of an Army, working in close touch with the General Staff, is responsible to the Army Commander for the co-ordination of Corps Artillery Defence Schemes and for the general supervision of all artillery defence measures. The G.O.C., R.A. of a Corps, similarly working in conjunction with the General Staff, is responsible to the Corps Commander for the preparation of the Artillery Defence Scheme of the Corps, and for the execution of all artillery measures approved by the Corps Commander. The organization of the barrage is the direct concern of the Corps, but in this matter Divisional Commanders are vitally interested as regards the actual fronts to be barraged (see para. 23), and should therefore be consulted.

f. In the case of an attack on our part with a limited objective, the general conduct of the operations can be more or less pre-arranged throughout their course, and the necessity of artillery control by the higher command has become recognized as a principle.

In defensive operations, however, greater elasticity of control is required. At a time when rapid changes in the situation are bound to occur, it is essential that the initiative should be taken by lower formations.

Brigade, battery, section and even single gun commanders must be so trained as to be imbued with the necessity of deciding and acting for themselves. In order to facilitate this principle, the closest liaison must be established between Divisions and such R.G.A. Brigades as cover their front, and also between all R.F.A. and R.G.A. formations. Furthermore, artillery tasks in the event of attack by the enemy should be clearly defined by Corps beforehand, as far as is possible, so as to guide brigade and battery commanders as to the direction in which they must develop their responsibility.

On the other hand, Armies and Corps must at all times be able to concentrate the weight of their artillery power on the area where it is most required. That they may be able to assume command at once and without confusion again demands a supple and elastic organization, combined with a tried and rapid system of transmission of orders and information.

A satisfactory organization will not of itself command success. A high standard of drill and training, foresight, and the utmost energy in preparation are just as necessary to the successful conduct of artillery in a defensive battle as they are in offensive operations.

III.— ARTILLERY DEFENCE SCHEMES.

3. *The Siting of Artillery in the Defense.* — The offensive principle of siting all batteries as far forward as possible has evident disadvantages when offensive preparations are not immediately in view.

Barrage batteries especially should not be situated too far forward, nor should they be massed, for under these conditions they may be too easily neutralized by the enemy's artillery before they can open a decisive fire. A distribution in depth provides a certain security against a large amount of artillery being put out of action simultaneously, and makes the enemy's counter-battery work, especially with gas shell, more difficult. A proportion of the Heavy Artillery will be required for counter-battery work during normal trench warfare. To enable this task to be satisfactorily performed, a certain number of batteries must of necessity be sited in forward positions, and, as the object of this is to obtain maximum range from their guns or howitzers, it is clear that counter-battery requirements should have prior claim in the allotment of weapons of long-range pattern. It must be remembered that in the event of an intended offensive by the enemy, his batteries are certain to be brought up to closer ranges in order that they may adequately support his infantry.

The foregoing considerations, combined with the necessity of being prepared to meet a heavy surprise attack on a large scale, which in its initial stages is practically sure to gain ground in certain sectors to an appreciable depth, show how essential it is that artillery, just as much as other arms, should be distributed in depth for purposes of defence.

As a general guide, the artillery of the defence should be disposed on the plan shewn in Plate I. The actual siting of batteries must, of course, largely be governed by the ground and by the situation of the various rearward lines of defence.

As regards Field Artillery, the importance of siting field batteries in such a way as to avoid any dead ground cannot be over-estimated. It is most important that the majority of the 18-pdr. batteries in any defensive sector shall be able to bring fire to bear well this side of our front line. This requirement is much facilitated by siting batteries well back, and this again makes it possible for artillery to carry out several tasks from one position.

4. *Alternative, Reinforcing and Rearward Positions*

Alternative positions should be maintained for all Field batteries, and, as far as practicable, for those of Heavy and Siege Artillery as well; these positions should be ready for immediate occupation in the event of the original ones being definitely located by the enemy. Constant movement by the heavier natures of artillery is impracticable, but the use of alternative positions and of roving sections or single guns should be exploited by Field Artillery. Such measures, carried out with circumspection and not too frequently, serve to mislead and mystify the enemy.

Positions for reinforcing artillery must be selected, and prepared as far as labour and material admits; some of those maintained as alternative positions may be available for the defence of the front line.

Positions for covering the rearward systems of defence must also be selected and clearly marked, even if labour is not available to undertake their actual construction.

Such positions must be sufficiently numerous to allow both for the withdrawal of artillery from the forward positions and for the advent of such reinforcements as may be expected.

It is, of course, most necessary that the routes to all rear-ward positions should be reconnoitred, selected and definitely allotted.

5. *"Dummy" Positions.*—"Dummy" gun emplacements often serve a useful purpose,

provided that they faithfully resemble real emplacements down to the smallest detail. Tracks up to them must be made and even short lengths of tramway laid. Particular attention must be paid to imitating the blast marks made by the nature of gun or howitzer supposed to occupy such emplacements, as on air photographs the absence of these marks is usually a reason for deciding that a position is unoccupied.

On fine days, when hostile aircraft are up, fires should be lighted close to "dummy" position; "flashes" may be fired from them, provided that an actual battery is firing at the same time. If roving sections or guns occasionally fire from these positions, the illusion will be heightened.

If any real emplacements have been abandoned owing to hostile artillery fire, a few rounds should occasionally be fired from them.

6. *Close Defense Guns.*—Single field guns in advanced positions may prove of great value in case of an attack by infantry or tanks. (See para. 36.)

Such guns should not in principle be so close to our front line or to other clearly defined localities as to be likely to succumb to the effects of the enemy's preparatory bombardment. Their value lies in the ability to deliver a sudden fire over the open sights at comparatively short ranges on either hostile infantry or tanks as they enter our lines, or, more particularly, as they endeavour to penetrate our defensive system. These guns should never, of course, be fired except in the case of an actual attack by the enemy. It is essential that arrangements should be made so that guns can be run out of their pits into the open in case of need.

7. *Construction, Protection and Concealment of Battery Positions.*—It is more than ever important that attention should be paid to concealing battery positions from the air. Camouflage should be constantly improved, and the resulting work studied by means of air photographs.

Regularity is particularly to be avoided. Guns should, as far as possible, be disposed in an irregular line, and as far apart as is compatible with adequate control; the latter consideration not only makes it more difficult to locate them, but also minimises the effect of individual hostile shells.

Blast marks must be obliterated or concealed. Tracks and tramways should never come to a dead end in a battery; they may be advantageously continued on into a "dummy" position.

As regards the protection of positions, the stronger the cover provided (combined with efficient concealment), and the more thorough the organization of the positions themselves, the better able will batteries be, both physically and morally, to fire effectively in the face of a superior artillery on the day of battle.

All work on battery positions should be carried out on a regular system, so that improvement is continuous. As a general guide, the order of importance of work to be carried out on a battery position is: —

g. Concealment.
h. Weather-proof cover for personnel and ammunition.
i. Shell-proof cover for battery command post, (including telephone dug-out).
j. Shell-proof cover for personnel and car-tridges, and also for shell of the lighter natures of artillery.
k. Subject to concealment, overhead cover for the protection of the detachments when in action and of the equipment.

Arcs of fire should be as wide as possible, and gun emplacements must be so constructed that guns can be run in or out without difficulty. It must be remembered that fire may be required in any direction, and that the embrasure of a gun pit may at any time be blocked by a chance shot.

All battery positions within 3,000 yards of the front line should be wired. This principle should be extended, as labour allows, to all battery positions situated in the various defensive systems. Prepared for all round defence, they may prove of great value as rallying points; batteries will eventually be provided with machine guns, and these, together with the rifles allotted to them, will enable a stubborn defence to be organized by the commanders concerned.

8. *Command Posts.* — Artillery Command Posts must be selected by General and R.A. Staffs in consultation. They must be so sited that they are likely to be out of constant shell-fire, since once communication between artillery commanders and their batteries becomes impossible, or even difficult, organized control ceases.

In the case of infantry and R.F.A. brigades, it is of immense advantage if their respective headquarters can be close alongside one another, always provided that there is reasonable prospect of the artillery commander's signal communications with his batteries and his C.R.A. remaining continuously open. In Divisions and higher formations it is essential that the General and R.A. Staffs should be close together during active operations of any nature.

9. *Observation.* — In the early stages of our offensive battles, at any rate during the period of the actual infantry advance, the great part of the supporting artillery fire is necessarily delivered mechanically in the form of barrage fire and of a general scheme of neutralization of the enemy's batteries. This fact, and the ever-increasing share taken by the R.F.C. in assisting artillery observation, has perhaps led to neglect of the importance of ground observation. Whenever attacking infantry are halted for any considerable time, or as soon as the final objective of the day is gained, the immense importance of ground

observation has been exemplified again and again.

In defensive operations, at the moment when the enemy's attack is launched, barrage fire is necessary. It must always be possible to open this fire immediately, in any circumstances and at any hour of the day or night. It must therefore be capable of accurate and instantaneous delivery without observation, and hence be automatic.

But with the exception of this barrage fire, it is not too much to say that observation is essential to the successful application of all artillery fire in a defensive battle. In this case there can be no fire based on pre-arranged programmes, and the possibilities of observation from the air may be severely curtailed. Time will be a matter of vital importance, and artillery fire, if it is to be of any real value, must be accurately delivered where it is most required.

Direct observation from the ground, which under these conditions is the only basis for accurate shooting, therefore becomes a matter of decisive importance.

These considerations necessitate the construction throughout the front of a system of observation posts, with as secure communications as possible (see para. 10). They must be provided so that no portion of the foreground is left unwatched, special regard being paid to the junctions of Corps and Divisions. The hostile country must be kept under observation, not only by day, but also by night, so that the flashes of the enemy's guns may be observed and the work of locating his batteries thus extended.

All Artillery Headquarters, from Corps downwards, should possess a map showing what can be seen of the enemy's defences and territory from each O.P. under their control, and also a photograph of the view from each.

In the construction of O.P.s it must always be remembered that cover from weather and freedom of movement are essential to good work. Concealment must be most carefully studied, and with this must be combined the maximum possible amount of protection from shell fire, so that there may be a reasonable probability of these posts surviving the enemy's bombardment and barrage fire.

It follows that O.P.s should not be nearer to the front line than is absolutely necessary. About 500-600 yards back may be regarded, generally speaking, as a suitable distance, though occasionally they may be as much as 1,000 yards in rear.

In certain parts of the line the configuration of the ground will make it inevitable to have O.P.s in or close to the front line, and in such cases reserve O.P.s must be arranged further back, whence fire can be controlled should the enemy succeed in breaking into our defensive system. Indeed, the observation system must be established in depth just as much as the batteries themselves. Every Group Commander, whether of Field or Heavy Artillery, should establish an observation station for himself in the close vicinity of his headquarters whence a general view of the country can be obtained and from which he can, if necessary, see for himself what is going on in his immediate front. A "crow's nest" in a tall tree will often meet the case.

Every battery must establish an O.P. close to its gun position, ready to be occupied should the enemy succeed in breaking through the forward line of resistance. In some cases it may be necessary to have more than one of these O.P.s available, in order to deal with any of the various situations that may arise.

All reserve O.P.s should be occupied as soon as an attack develops, or sooner if communication with forward O.P.s is lost.

O.P.s must also be selected, marked and tabulated in rearward areas in connection with the gun positions chosen for the support of each successive line of resistance. To what extent these can be prepared must depend on the labour available.

It is advantageous if all O.P.s are wired in and if they can be protected by flanking machine gun fire.

10. *Signal Communications.* — The high importance of observation demands as a corollary a system of communication calculated to withstand the natural conditions involved by a hostile attack.

All means of communication available for the use of the Artillery must be considered and systematically improved in consultation with the Senior Signal Officer of formations.

The following points should receive attention: —

l. Telephone dug-outs and exchanges must be made practically impervious to artillery fire.
m. Telephone lines should be buried right up and into O.P.s.
n. The exchange system between batteries and O.P.s should ensure the possibility of alternative O.P.s being used by batteries.
o. The telephone system must be capable of extension, so as to meet the needs of considerable reinforcements.
p. Communication between Artillery and Balloons, Sound Ranging Sections and Observation Groups, must be such as to ensure efficient observation of fire.
q. Arrangements should be made so that rear-ward positions, O.P.s, etc., can be quickly connected up to the existing telephone system.
r. All alternative means of communication (wireless, lamps, flags, discs, carrier pigeons and orderlies) must be fully considered and so arranged as to replace immediately the telephone system in the not improbable event of its partial breakdown.

Every artillery O.P. that is manned by night should be provided with a complete equipment of "S.O.S." light signals. Those should invariably be used in addition to any telephone or other signal message sent. "Repeating stations" must be established wherever necessary.

The rapid transmission of "Alarm" signals to the actual guns requires the greatest care and forethought. The only sure test of a thoroughly efficient system of communication is that messages get back from the front line to the guns at once at night or in foggy weather, even though the telephone system has broken down.

11. *Liaison between Artillery and Infantry*. — As already pointed out in paras. 1. and 2, flexibility of organization and mobility are essential to the successful employment of artillery in the defensive battle. These principles demand the closest touch between artillery and infantry. Personal liaison between the commander of an infantry formation and the commander of the supporting artillery is the best form of liaison on all occasions. It is for this reason that it has been laid down (see para. 8) that the headquarters of such commanders should, if possible, closely adjoin each other. If is not feasible, then liaison between artillery, both R.F.A. and R. G.A., and infantry must be ensured by the attachment of responsible artillery officers to the infantry formations concerned.

As regards liaison between batteries and battalions, it is to be understood that the right place for a F.O.O. during the hours of daylight is at his O.P. There he can see the front with which he is concerned and is responsible for bringing fire to bear if required. Thus he must be able to pass a call for fire more quickly than it could possibly be conveyed if emanating from a liaison officer with a battalion.

By night (apart from O.P.s manned for counter-battery purposes and those used as repeating stations for S.O.S. calls) F.O.O.s are unable to carry out their primary duty—observation—and a liaison officer should remain with every battalion.

The closest touch between R.G.A. Brigades and the Division whose front they cover must always be ensured.

12. *Co-operation of R.F.C.*—Photographic records of the areas in which gun positions are likely to be constructed are of great importance. These photographs should be taken at regular intervals in order that the progress of the enemy's preparations may be followed.

Once the battle commences, the principal role of the Royal Flying Corps will be observation for the artillery. At this period, therefore, everything must be subordinated to the duty of keeping our own artillery machines in the air. If this object can be attained it will be of far greater assistance to the infantry and artillery, though invisible to them, than any amount of low-flying or bombing against the enemy's front line troops.

13. *Fire Direction and Control.*—Ability to open at once an accurate fire at any hour of the day or night must be the ideal of every battery, and all artillery commanders must seek to develop in this respect a constant improvement in their commands. When any important firing is to be carried out, or when a condition of abnormal activity prevails, observation posts should always be manned by officers of some standing and discrimination.

Orders as to checking ranges daily on datum points, routine firing and concentration schemes; the provision of battery boards for reinforcements, as well as for batteries in the line; measures to improve co-operation by Observation Groups, Sound Ranging Sections and Balloons; care of material; the system of transmitting orders and information from all sources to the guns; arrangements for opening annihilating and barrage fire; all these matters require constant attention, and improvement will only be marked if commanders not merely issue orders on these subjects but by test and by personal supervision ensure a satisfactory execution of the principles laid down.

Full consideration must be paid to the advantages to be derived from enfilade fire and from concentrations of fire.

Enfilade fire over parts of the enemy's front line may be possible from batteries sited in normal positions, but it should be particularly regarded when siting forward guns, or employing roving sections. Under the ordinary conditions of trench warfare the amount of artillery in the line is not very large, and it is therefore an economy in gun-power to arrange for enfilade fire, as far as is possible, without infringing the principle of distribution of artillery in depth. The value of this nature of fire is apparent not only for routine firing but also in counter-battery work, bombardments, and, when safety considerations admit, in the defensive barrage.

Concentration of fire is a principle applicable to many situations. Its object is to exert a maximum artillery effort on a given target, combined very often with an intention to effect surprise.

It follows, therefore, that careful arrangements and clear orders are necessary if this form of fire is to attain the best results and is to be capable of being carried out at short notice. Every Artillery Staff should maintain a chart showing what batteries can concentrate their fire on each map square; by this means it is possible to see at a glance the number and calibre of guns that can fire on any given target.

A concentration of fire by several batteries in no way implies a haphazard rain of projectiles over the target concerned. Each battery must be assigned a definite portion the target or a distinct lane or area to cover with fire. To what extent ranging should be carried out depends upon the target and on the situation; ranging, for instance, is inapplicable to concentrations of fire on important fleeting targets ("LL" call), while on the other hand accuracy of fire is essential to the deliberate destruction of defences.

To obtain the benefits of surprise and to achieve the greatest moral results, concentrated fire for effect should always be opened simultaneously. It should be remembered that a concentrated fire will be the more effective in accordance with the care taken in the selection of the batteries to take part, with regard to their nature, ammunition and line of fire; oblique and enfilade fire, as already pointed out, present considerable advantages in this circumstance.

14. *Routine Firing.*—Artillery fire during quiet periods of trench warfare tends to become

spasmodic, and therefore wasteful of ammunition unless definite principles of conduct are employed.

To what extent the initiative should be taken in artillery action against the enemy depends entirely on the general situation, and is a matter for the decision of the High Command. On the other hand the enemy's activity must be countered, when necessary, on clear and organized methods.

Artillery "retaliation," the automatic discharge of a number of rounds at the opposing trenches, is useless. When the action of the hostile artillery becomes so aggressive as to demand reprisal, our action should take the form of an organized, fierce and concentrated fire against definite and selected targets whereon appreciable damage is likely to be caused. Care should therefore be taken not to shell empty trenches with shrapnel; when it seems best to direct our fire on the enemy's trenches, a definite target (machine gun or trench mortar emplacements, dug-outs, etc.) should be selected for destruction.

Shrapnel fire may, however, be employed with great advantage after a destructive shoot with the object of inflicting casualties on repairing parties.

It is advisable that all ordinary shooting (harassing fire, engagement of working parties, small reliefs, etc.) should be carried out by roving guns or by single guns or sections sited some few hundred yards away from the main battery position, which by this means can be kept "silent." It is a mistake to unnecessarily disclose guns, the presence of which it is desired to conceal.

15. *Mobile Reserves.*—That mobility is the essence of artillery action in the defence has been emphasized in the opening section of this book and the application of this principle occurs at all stages of the defensive battle. A proportion of the artillery at the disposal of divisions and of higher formations must always be kept as a mobile reserve so that artillery may with certainty be available, both to reinforce a threatened front and to support the counter-attack (see Section VI.) by surprise fire.

16. *Vulnerability of Artillery Teams.*—Care must be taken to avoid, as far as possible, exposing artillery horses to attacks by low-flying enemy aeroplanes. For this reason wagon lines should not be massed together, and every opportunity should be taken to keep horses under cover from view. Artillery on the march presents a vulnerable target and all movements should therefore be carried out as smoothly and expeditiously as possible.

IV— COUNTER-PREPARATION.

17. *Natures of Hostile Attack.*—A hostile attack on a large scale may be launched, broadly speaking, in one of two ways; either with the object of achieving the utmost measure of surprise, or after full artillery preparation.

In the first case the enemy will make every effort to conceal his intentions, and, should he succeed in doing so, the counter-preparation of the defence will have to rely on the immediate development of annihilating fire or, possibly, only of barrage fire at the last moment.

If, on the other hand, the enemy intends to deliver an attack after full preparation, numerous indications will inevitably be forthcoming; widespread railway construction, the digging of new battery positions and trenches of various natures, increased wireless and aircraft activity, the formation of dumps and the arrival of new batteries on the front are among the number. In this case the artillery counter-preparation of the defence will be able to observe in their entirety the principles laid down in the following paragraphs.

18. *Definition of "Counter-Preparation."* — The term "counter-preparation" in its wide sense includes all the measures taken by the defence to hinder the enemy's preparation for an attack. It must automatically come into being from the first moment when a hostile intention to attack is suspected.

The characteristics of counter-preparation are therefore clearly defined, and, as far as artillery is concerned, consist of:

s. Counter-battery work.
t. The bombardment of rearward communications and establishments, and harassing all work and movement in the enemy's trenches.
u. The destruction of the enemy's infantry defences, garrisons and assembling troops.

It is clear that material advantage will be derived if the defence can succeed in opening the artillery battle first. It is therefore essential that all measures of counter-preparation should be fully thought out and arranged, so that they can be put into immediate execution, with the object of hampering the enemy's preparations from the very outset, and before he is in a position to develop the full power of his artillery.

19. *Counter-Battery Work.* — The principles and practice of counter-battery work under varying conditions are fully discussed in "Artillery Notes, No. 3—Counter-Battery Work" (S.S. 139/3), and "Co-operation of Aircraft in with Artillery" (S.S. 131).

It only remains therefore to emphasize those points which are particularly applicable to the circumstances of the defensive.

The first principle is always continuity of counter-battery work on organized lines; that is to say, relentless energy in counter-battery intelligence and persistent destruction of hostile batteries in accordance with the resources available and the requirements of the moment.

As soon as an intention on the enemy's part to attack is apparent, or even suspected, effective counter-battery work becomes a matter of exceptional importance to the defence. By means of continual losses the fighting power of the hostile artillery may be impaired to such an extent that it will be unable adequately to fulfill its chief mission, the preparation of the infantry attack. Moreover, if the enemy's batteries arc strongly attacked by our artillery they will be less able to bombard our defensive organizations and infantry garrisons, whose fighting power will thus be maintained till the infantry combat begins. It is, however, a vital condition of the defence that at the moment when the enemy's attack is launched, a prompt, accurate and adequate artillery fire shall he brought to bear on his infantry. If, therefore, the numerical superiority of the enemy's artillery is such that the counter-battery duel must inevitably turn to his advantage, then the counter-battery work of the defence may have to be severely curtailed. Under these conditions the enemy's superiority may best be countered by a judicious use of alternative positions, by fire to destroy the dumps, railways, roads and tracks by which the enemy's batteries are fed, and by strong concentrations of gas shell at opportune moments. The exhausting effect produced by persistent gas shelling on the detachments of hostile batteries situated in localities where gas is not easily dissipated should be borne in mind. The bombardment of observing stations is another matter that must not be overlooked.

20. *Bombardment of Rearward Organizations and Harassing Fire.*—The principles of harassing fire in the offensive (see "Artillery in Offensive Operations," S.S. 139/4, Section V.) and in the defensive are the same, but this form of artillery action assumes in the defensive even greater importance. If successfully applied, it may well cause very serious losses and, at least, delay the enemy's offensive action, thus contributing a distinct point to the favour of the defence.

The essentials to successful fire action in this respect are: —

v. Careful selection of the most favourable targets, based on systematic study of maps, air photographs and other intelligence sources.
w. Intelligent variation of fire programmes so that it shall be impossible for the enemy to feel that any particular area or route is immune from shell fire.

The targets selected should include important railway centres and junctions, billets, headquarters, signal centres and approaches and communications of all natures.

Works in the neighbourhood of the enemy's front system of trenches that have been subjected to bombardment by the artillery of the defence must also receive vigorous attention.

Gas-shell bombardments may be very effective under suitable conditions. These shell may be profitably employed in various ways, provided always that weather conditions are not unfavourable to their use and that they are expended in sufficient quantity. The principles of gas shelling are laid down in S.S. 134 "Instructions on the Use of Lethal and Lachrymatory Shell." It must always be remembered that gas shell will have the greatest effect against living targets who are, by reason of their duties, unable to escape from the infected area. It is for this reason that gas shelling assumes such an important place in counter-battery work. (see "Artillery Notes, No. 3—Counter-Battery Work," Section V., 37.) A continued bombardment will prove most exhausting to the gun detachments, and will eventually reduce them to impotence. In this connection it may be remarked that a gas shell bombardment of batteries sited close to roads or other main avenues of approach will often produce a double effect, neutralization of the batteries and also denial of the road, etc., to traffic for some time.

Gas shell will also be effective against concentrations of troops in assembly formations or in billets and bivouacs, especially in valleys, woods, quarries and other localities where the effect of wind is lessened. In order to obtain the greatest effect a gas shell bombardment should be always initiated as far as possible as a surprise; but, apart from this, gas shelling at all times compels the enemy's troops to put on their masks and thus hampers their activity and tends to produce exhaustion.

Gas shelling by night conduces to surprise, is generally favoured by weather conditions and is particularly effective in that it denies sleep or rest to those attacked.

As in offensive operations, infantry must co-operate with artillery by means of direct and indirect machine-gun fire. Special measures should be taken to deal with any known or suspected reliefs or assemblies of troops or tanks. In all fire of this nature the use of roving guns and sections should be exploited to the utmost. This primarily applies to harassing fire on the enemy's forward zone, but the greater the extent to which the principle can be adopted, the less will the enemy be able to neutralize the guns that cause him annoyance and loss. Careful organization is a matter of the greatest importance, as without this it will inevitably occur that certain targets receive an unnecessarily large volume of fire, while others are neglected.

On no account must harassing fire be permitted to die down during the early hours of the morning.

21. *Destruction of the Enemy's Infantry Defences.*—To what extent destruction by the defender of the enemy's trenches and strong points is of value is a matter demanding due deliberation. The destruction of selected points in the enemy's defensive organization is, generally speaking, a necessity for the attacking force in order that material obstacles to the advance of the assaulting infantry may be sufficiently reduced.

Where the defensive is concerned, the object of destroying the enemy's trenches and strong points is based on other considerations.

Wholesale destruction of the opposing trenches is out of the question; partial destruction will not prevent the delivery of an attack. Therefore, whatever ammunition is devoted to such tasks must be expended with a definite object in view.

An enemy preparing to deliver an attack can be materially damaged in three ways by means of fire against his trench system.

x. By bombardments calculated to achieve good effect on his trench garrisons. It follows that the bombardment of unoccupied trenches must be studiously avoided.

y. By the destruction of forces designed to assist his infantry assault, i.e., such machine guns, trench mortars, forward guns, tanks, gas installations and similar targets as can be definitely located.

z. By the destruction of assembly trenches and other works expressly designed to facilitate the delivery of the assault.

For these purposes, zones, areas or lanes must be allotted to the artillery of the defence just as for the preparation of offensive operations. Accuracy of fire, and therefore, observation, are of the utmost importance under defensive conditions, for it is essential that the defending artillery, which will usually find itself numerically inferior, must compensate for any such inferiority by technical superiority of fire. Destructive fire by night will therefore rarely be justifiable, though short and sharp bursts of fire designed to inflict casualties on living targets should constantly be employed.

22. *Destruction of the Enemy's Infantry (Annihilating Fire).*—The casualties caused among the enemy's troops by harassing fire and by the bombardment of his infantry defences will be commensurate with the forethought and accuracy with which such artillery fire is applied.

But as soon as an attack threatens, special measures must be brought into force with the object of causing the enemy's infantry, while assembling for the assault, such losses that the attack will not be delivered at all, or, at least, only half-heartedly. An annihilating fire must be promptly directed on those trenches, dug-outs, communication trenches and dips in the ground wherein the attacking troops, and possibly tanks, are believed or are actually seen to be massing. Careful and continuous observation, both from the ground and from the air, of the enemy's lines and back areas is important in order that any massing of troops by the enemy may be noticed in time and fire opened at once on such targets, with observation if possible.

The threat of an attack, however, by no means depends solely on actual sight of the enemy's assembling troops; it may be betokened by the approach of abnormal numbers of aircraft, by the presence of tanks or by an intense bombard-ment. Again, an intended attack may be given away by prisoners, deserters, or listening posts.

It should be borne in mind that attacks on a grand scale, especially if accompanied by tanks, are likely to develop about dawn. If, therefore, an attack by the enemy is expected shortly to take place, bursts of annihilating fire shortly before daybreak and occasionally before dusk may bring about great results, especially if accompanied by increased harassing fire during the hours of darkness.

It is obvious that a violent fire cannot be maintained for an indefinite period, and hence annihilating fire should be reserved for moments of maximum tension. At other times the enemy's bombardment must be met by the measures described in the previous paragraphs.

Annihilating fire, to produce its full effect, must be concentrated as regards both time and space, and should therefore consist of short bursts of rapid fire. The principle of concentration demands in its turn a careful organization. Areas or zones must be allotted to the various natures of artillery, and, as far as possible, targets should be allotted beforehand to batteries. Schemes for annihilating fire must deal with a general attack along a whole Corps front and also with attacks confined to divisional and brigade sectors.

Although premature interruption of counter-battery work is to be avoided, at moments of extreme tension the engagement of the enemy's batteries becomes a matter of minor importance, and the full power of the defending artillery must be devoted to the overwhelming of the enemy's infantry. At the same time it must always be possible to engage at once especially favourable or dangerous targets, such as columns in movement in back areas or assembled tanks, or to afford support to neighbouring sectors. It is also essential that annihilating fire should be capable of immediate conversion to barrage fire should the enemy's infantry succeed in leaving their trenches.

The foregoing considerations exemplify very strongly the need for flexibility in the artillery organization of the defence (see paras. 1 and 2). This suppleness must ever be regarded as a cardinal principle, as without it the ability of the artillery to meet its many obligations will also be wanting.

V.—THE REPULSE OF ASSAULTS (BARRAGE FIRE).

23. *The Principles of Barrage Fire.*—The object of barrage fire is in the first place to destroy an enemy during the actual delivery of his assault, and secondly, to prevent the advance of his supports and reserves, thus paralysing the attack. The essence of effective barrage fire is that it shall be of the greatest volume possible, accurately placed and automatically available under any circumstances and at any time.

The quantity of field artillery allotted to any particular front during periods of normal trench warfare is such that the density of the barrage which can be put down to break up an attack on a large scale will not suffice for the whole front.

Artillery barrage arrangements must therefore aim at denying to the enemy an advance against the more important tactical features of the defence, rather than to establish a uniform and therefore comparatively weak barrage along the whole front. For the defence of the intervening portions of the line reliance must be placed on machine gun and trench mortar fire.

It follows that the selection of the fronts to be covered by barrage fire rests primarily with divisional commanders, and that co-operation between divisional artillery and machine guns must be of the closest.

The advent of artillery reinforcements will naturally increase the front that can be adequately barraged.

It must be clearly understood that at the critical moment, when the enemy's infantry leave their trenches to attack, every single weapon of the defence must be devoted to their destruction. For the time being counter-battery work must cease. Artillery, infantry, machine guns and trench mortars must all combine with the object of mowing down the advancing waves and to shatter those waiting in readiness in rear.

24. *The Field Gun (18-pdr.) barrage.*—In principle field gun barrage fire should be put down as close as possible in front of the defender's front line; the safety of the front line garrisons must, however, be definitely assured.

If the opposing trenches are so far apart that the enemy's front trench does not lie within the 100 per cent. zone of the barrage on its original line of delivery, the barrage should search forward as far as the enemy's front line and then creep back to its original line.

Where, on the other hand, the opposing trenches are so close together that the barrage cannot be safely brought down upon the enemy's jumping-off trenches, much of the value of the barrage is lost. The task must then be left to trench mortars, machine guns and rifles, while the field artillery fire is directed upon the enemy's support line and nearer communication trenches.

Although frontal fire facilitates observation and communication, the value of enfilade fire in the barrage must always be remembered, particularly where the amount of field artillery available is small. It will often be difficult to arrange, but it greatly assists to strengthen or complete the barrage curtain.

25. *The Field Howitzer and Heavy Artillery Barrage.*—The field howitzer barrage will generally follow the same principles as those of the field gun barrage, strengthening the latter, but necessarily, for safety reasons, being placed at a somewhat increased distance from our front line.

The part taken by Heavy Artillery depends chiefly on their natures and on the distance at which fragmentation of their shell on bursting is dangerous to our own troops.

Howitzers with No. 106 fuze are a formidable man-killing weapon, and high velocity flat trajectory guns have great shell power and deep searching effect. The role of 6-inch howitzers is essentially to increase the barrage proper by fire to prevent the advance of the enemy's troops waiting in rear to follow the foremost waves. The heavy howitzers and long-range guns may be said to continue to deliver annihilating rather than barrage fire, inasmuch as their specific task is to tie to the ground and to destroy the enemy's supports, reserves and reinforcements.

26. *Organization of the Barrage.*—The selection of "S.O.S." lines, the density of barrage fire and the rapidity with which it can be opened must be the particular concern of the

General Staffs of Corps and Divisions. Barrage fire entails a great strain on personnel, material and ammunition resources, and it is therefore of the very highest importance that it should never be called for except under the actual circumstance of attack. The more completely this principle is accepted, the more fully will the artillery appreciate how incumbent upon them it is that their barrage fire shall, when called for, invariably reach the highest stage of perfection. On the other hand, it is clear that the more effectively annihilating fire and other previous artillery tasks are carried out, the less often will a hostile attack be able to materialise. Barrage fire will ordinarily be called for by infantry or by artillery observers by means of the "S.O.S." call, that is to say, by means of light signals, and confirmed by telephone messages; visual signalling and every possible form of communication must be effectively organized as alternative means of getting this message through to the guns under all conditions (see. para. 10.). It is impossible to pay too much attention to ensuring that barrage fire shall be opened with the least possible delay. At the same time, battery, section and single gun commanders must by their personal diligence be prepared to open barrage fire even without the receipt of a "S.O.S." call. This particularly applies by night, when observation is often impossible; an intense hostile bombardment or the outbreak of a violent fusilade may justify the immediate opening of barrage fire without orders. Any battery, etc., commanders opening fire under such circum-stances must, of course, take immediate steps to discover the real situation.

The duration of barrage fire on the receipt of a "S.O.S." call and the rates of fire for the various natures of artillery must be laid down by Armies and Corps. It must be remembered that to continue firing on "S.O.S." lines at barrage rates for an indefinite period is not only wasteful in every respect, but cannot be justified by results. The enemy's attack must either have failed or to some extent succeeded, and in both cases the original distribution of barrage fire can no longer be entirely applicable.

It is advisable that orders should lay down a high rate of fire for the first five minutes or so, the rate then gradually decreasing unless a further "S.O.S." signal indicates that barrage fire is still required.

Should the enemy succeed in entering our lines, barrage fire must be brought back on to those portions of our trenches occupied by him. Such action must be definitely warranted, either by demand from the infantry or by the actual observation of artillery observers; in any case, great care must be taken to describe explicitly where fire is required. It is this contingency that renders it so important that the majority of barrage batteries shall be able to direct their fire well this side of our own front line.

At the same time part of the available artillery must be devoted to preventing the advance of the enemy's supports and reserves.

The role to be taken by machine guns in repelling hostile assaults must be carefully worked out and co-ordinated with the artillery arrangements. The necessity for covering those parts of the front untouched by artillery fire and also the advantage of strengthening the artillery barrage by means of machine gun fire must both receive full consideration.

Artillery commanders must work in close personal touch with Divisional machine-gun commanders and the officer in charge of machine guns at Corps Headquarters, so that the best results may be obtained from the combined efforts of the two arms.

One point may require special attention during winter months. Ground that is ordinarily marshy may become frozen over, and so for the time being be passable to infantry. This possibility must receive due consideration in the selection of "S.O.S." lines, and arrangements made temporarily to barrage any frozen surfaces that may be adjudged important from the point of view of the defence.

27. *The Support of Neighbouring Sectors.*—It should be possible to switch barrage fire from one area to another as if by word of command. But to what extent barrage batteries should in practice be directed from their own "S.O.S." lines to strengthen the barrage of a neighbouring sector is a matter that demands special consideration. In the case of hostile trench raids, once the enemy's point of attack has been definitely established, it will usually be justifiable to afford any additional assistance required, particularly as far as Heavy Artillery is concerned. But in the event of a hostile attack on a large scale, or even of a raid where the front of attack is not clearly defined, a premature diversion of the fire of barrage batteries from their own front is to be strictly avoided. For until the situation is clear, such a diversion of fire may result in leaving a sector devoid of its artillery protection in the face of a subsequent attack, without adding very effectively to the barrage of the adjoining sector. Where it is decided that assistance can be given to some extent, it will be most economically and effectively afforded by means of enfilade or oblique fire. All measures of assistance must very carefully worked out and periodically practised.

VI.—THE SUPPORT OF COUNTER-ATTACKS.

28. *Principles of Artillery Action.*—Efficient artillery support to the counter-attack will require the most resolute action and the exercise of the highest form of initiative; all artillery commanders, including Battery and Section Commanders, must be trained to act, when the occasion arises, independently and with complete self-reliance. Besides the power of quick and sound decision, mobility, reconnaissance and observation are essential to successful artillery action in support of counter-attacks.

29. *Immediate Counter-Attacks.*—If the enemy succeeds in entering our front line trenches, the first mission of the artillery is to cut off the enemy's supports and reserves by means of annihilating fire and at the same time to bring back the barrage on to those parts of the line captured by him. (See para. 26.) Observation from the ground and from the air and communication with the infantry must be re-established, if interrupted, in order that artillery fire may quickly be concentrated where it is most required, and that our infantry may not be hampered in their counter-attacks by our own artillery fire. At this time the employment of isolated guns and of mobile artillery units (batteries and sections) which know the ground may well result in striking success. Mobile units should either have their teams close to hand or may occupy positions in observation. (See F.A.T., Chap. VIII,

Section 184.)

Boldness must form a marked characteristic of their action, so that the utmost benefits of surprise may be afforded by their fire and that the infantry may be conscious of vigorous and visible support. The enemy's assaulting troops will still be in ground unknown to them, and his artillery will, in all probability, be unable to locate the silent or mobile artillery of the defence. To facilitate the advance of such artillery under heavy shell fire, every opportunity should be taken of utilising gaps and pauses in the enemy's fire. This again calls for rapid reconnaissance and quick decision.

If the early counter-attacks by our infantry fail and the enemy succeeds in breaking further into our system of defence, the primary duty of the artillery is to arrest his advance. The first essential to this end is a well-devised system of observation posts throughout the various zones of defence. (See para. 9.) These posts must provide a good view, if possible, without any gaps, not only over all the ground in front of our lines, but also over the area between and in rear of them. With such powers of observation, the mission of the artillery is greatly facilitated. A careful distribution of fire and co-operation with mobile artillery reserves and with rearward machine guns must be fully prepared beforehand in order that the enemy's advancing infantry and also his reserves may both be suitably engaged. Flank guns of field batteries must be pulled out of their pits (see para. 36) so as to be able to engage the enemy over the open sights from whatever direction he approaches. Batteries, too, must make the utmost use of their rifles and machine guns, in case of need.

It will be of considerable assistance at this critical stage in the battle if one or two field batteries in each divisional sector have been placed in action at a distance of 5,000 yards or so behind our front line. Strongly entrenched and remaining silent till the time of assault, they will be able to support counter-attacks in their initial stages while mobile units are coming into action.

30. *The Decisive Counter-Attacks.*—The employment of artillery to support decisive counter-attacks, carried out in accordance with orders issued by the Higher Command, must be based on the principles laid down for the offensive battle. (See Artillery Notes, No. 4, "Artillery in Offensive Operations," S.S. 139/4.)

It will, however, be particularly important that the flanks of the counter-attack should be fully secured by fire and that the protective barrage subsequent to a successful attack shall be strong in volume and deep in distribution. The principles of artillery preparation for such a counter-attack are precisely similar to those for an offensive battle, though time may necessarily be short. That an adequate force of artillery and of ammunition with the guns is available and can be maintained must above all be ensured.

In working out the details of the artillery preparation and support, special attention must be paid to the question of whether the artillery available on the ground is in a position to lend its full weight. If it is not in a position to do so, then part of it must be withdrawn and be re-established in new positions, or additional artillery must be allotted to the counter-attacking force from the outset. (See F.A.T., Chap. VII., Section 163). In either case, a certain number of mobile batteries should always form part of the force detailed for the counter-attack so as to contribute to the possibilities of surprise by decisive fire at short ranges from unlocated positions.

31. *Co-operation between Artillery and Infantry.*—In all cases where mobile artillery is detailed to support a counter-attack, of whatsoever nature, it is essential that the commander of the artillery should have opportunity of getting into personal touch with the commander of the counter-attacking force.

"Whenever a subordinate artillery commander is allotted a task necessitating co-operation with a certain force of infantry, whether he is placed under the orders of the com-mander of that force or not, it becomes his duty to open communication with its commander, reporting to him in person, if possible, in order to obtain full information as to the character of the operation that he is to support and as to the proposed method of its execution." (F.A.T., Chap. VII., Section 153.7.)

The infantry commander must indicate the targets on which he wishes the artillery to fire, but battery commanders must naturally not wait for these targets alone. Fire must on all occasions and without orders be directed on whatever holds up the infantry of the counter-attack, especially machine guns.

In principle some of the batteries, or even sections, allotted to the counter-attack should follow the infantry as far as possible, moving up over the open, and rely on firing with direct observation and over the open sights.

Besides the necessity of arranging that the commander of the mobile artillery detailed to support a counter-attack shall establish personal touch with the commander of the counter-attacking troops, it is particularly important in the case of early counter-attacks in force that the artillery already in the line shall be made aware of the conditions of the intended counter-attack. Unless this is ensured, the success of the counter-attack may be limited by the action of artillery unaware of the situation. At such a time normal com-munications are liable to be interrupted to a greater or less extent, and the difficulty of directing the fire of the artillery in the line will thereby be increased. Every endeavour must therefore be made to establish communication between counter-attacking divisions and the Headquarters of Divisional Artillery, Corps Heavy Artillery, or, at least, Brigades R.F.A. and R.G.A. already in the line. Generally speaking, the action of such artillery must necessarily be devoted to preventing the approach of hostile reinforcements, while all resistance opposed to the attacking infantry must be overcome by the artillery attached to the counter-attack troops.

In the case of decisive counter-attacks, delivered after full reconnaissance and preparation, no difficulties should arise on this account.

VII.—ARTILLERY IN REARGUARD ACTION.

32. Under certain conditions it may prove advisable for a force acting on the defensive to undertake a rearguard action, at any rate for a time, as, for instance, when deliberately withdrawing over a considerable distance to fight on a Battle Zone deliberately chosen and prepared in advance.

The principles of artillery action in such circumstances are laid down in F.A.T., Chap. VII., 166; this section should be carefully studied. Instructions as to the successive positions to be occupied by the artillery of the rear-guard should have been prepared beforehand and made known in time to those concerned. It is of particular importance that the routes of withdrawal for artillery shall have been carefully selected so as not to clash with the requirements of other arms, and that arrangements for the supply of ammunition to artillery of all natures shall have been worked out in detail for each step of the withdrawal.

In the face of a powerful hostile artillery, main roads running straight back from the front, villages and other defiles should, of course, be studiously avoided, as far as possible. Visual observation will, as in all phases of defensive operations, be a matter of vital importance in order that any false step made by the enemy and every favourable target presented by him may be met by an immediate and decisive artillery fire.

VIII.—ANTI-TANK DEFENCE.

33. *"Instructions for Anti-Tank Defence."*—Anti-tank defence is dealt with in detail in S.S. 203, from which the following paragraphs are quoted. The pamphlet in question must, however, be studied in connection with the general action of artillery in the defensive.

34. "*Artillery the Chief Means of Defence."*—Experience shows that artillery fire forms the most effective defence against tanks and that all other arms and weapons can only be regarded as subsidiary means.

"The moral effect produced by this new weapon of offence is considerable, and tanks should therefore be engaged at the earliest opportunity.

"But, as has already been stated, it is not so much the actual tank itself that constitutes the danger as the assistance which it offers to the enemy's infantry to break into our defences. Hence, it is essential that only those guns which have been specially detailed for the purpose should deal with tanks, all others devoting their whole energy to destroying the enemy's infantry."

35. *"Organization of Defence in Depth."*—"Artillery defence against tank attack, just as against infantry attacks, should be organized in depth both as regards the artillery holding the line under normal conditions and especially with regard to the plan for reinforcing the front where attack is threatened or takes place. Such an organization will ensure that any

tanks which escape early destruction will have to face artillery fire at all stages of their advance."

36. *"Engagement of Tanks."*—"The engagement of tanks prior to an attack depends primarily on their discovery by aircraft and on careful examination of aeroplane photographs. Tanks thus discovered will be engaged under the zone call system, or, if time allows, be deliberately destroyed by the concentrated fire of several batteries.

"At the beginning of an attack hostile tanks will have to pass through the defensive barrage fire, which should make it difficult for them to penetrate our lines.

"If the enemy's tanks are not stopped before reaching our trenches, the object must be sought by the employment of guns using direct laying, i.e., by forward guns, dug in and strongly protected. Sections of field guns should be brought up on the first warning of a tank attack to positions whence they can engage such targets over the open sights.

"Should even a few of the enemy's tanks succeed in passing through those forms of artillery defence already considered, they will by then have advanced far into the defensive system, and it becomes imperative to stop their further advance.

"It may be advisable to site single guns specially for this work, in the main area of field artillery concentration.

"Apart from this, in all batteries one or two guns (the flank guns are the most easily handled) should be told off to be run out, in the event of a tank attack, into positions in the open close to their batteries. Such positions must have a good view to front and flanks, so that direct fire can be brought to bear on advancing tanks.

"This procedure has been adopted by the enemy, and has in recent operations been the cause of the chief losses to our tanks. Prompt and accurate fire by these guns will restore what otherwise might prove to be a dangerous situation. Regardless of the position of our own troops, they must fire at the surviving tanks till they are definitely put out of action. The remaining guns of batteries will meanwhile continue to engage the enemy's infantry either by barrage fire or by individual action as the situation may require.

"O.P.s must be established and manned near all batteries so that selected guns may receive immediate news of the approach of tanks; they will equally prove of value in observing fire against advancing infantry.

"It may occasionally prove possible to employ 60-pdrs. in this way; in any case 60-pdr. batteries must be prepared to engage tanks approaching their positions, the heavy shell of these guns being particularly effective against such targets."

37. *"Ammunition."*—"All artillery specially detailed to engage tanks must use H.E. In the case of 13-pdrs. and 18-pdrs. No. 101 fuzes, with or without delay, should be used with H.E. against tanks, as with these guns No. 100 fuze (when available) cannot be relied

upon to be effective in all cases. With all other guns and howitzers any type of fuze may be used."

IX.—TRENCH MORTARS.

38. *Principles of Co-operation.*—The co-operation of trench mortars under all conditions is described in "Artillery Notes, No. 6—Trench Mortars" (S.S. 139/6).

In the defensive battle the principal role of trench mortars is to relieve the artillery of as much of the close range work as possible.

Light mortars should be disposed in depth and their positions selected with a view to supporting immediate counter-attacks in the event of the enemy penetrating into any of our defences.

Medium (6-inch) and heavy trench mortars should, generally speaking, be employed on the same lines as medium and heavy howitzers, within the limits of their range; that is, for bombardment and for annihilating and barrage fire. Medium mortars, in particular, should also be utilized to bombard and barrage in conjunction with machine gun fire those parts of the enemy's trenches which are either too close to our own for artillery to engage with safety or for which for any other reason artillery barrage fire is not available.

Trench mortars should not, in principle, be sited within 500 yards of our front line, for in such positions they are liable to be put out of action by the enemy's preliminary bombardment and to be over-run in the event of the enemy succeeding in entering our lines. It may, however, be necessary to place a proportion of the available mortars in advanced positions in order that they may be able to bombard particular portions of the enemy's front system of trenches. Shell-proof emplacements and alternative positions should be provided, as far as time and labour admit.

The chief difficulty in all trench mortar work is the transport and storage of ammunition. This fact must be recognised, and special carrying parties are essential. The moving of medium and heavy mortars to new positions and the preparations for opening fire take up considerable time.

X.—ACTION OF ARTILLERY IN ENEMY GAS ATTACKS AND SMOKE BARRAGES.

39. *Gas Attacks.*—Enemy gas attacks may be executed for purposes other than the preparation of a subsequent infantry attack.

During a gas discharge from gas cylinders a heavy-artillery fire on the actual trenches whence the gas is issuing is the best way of dealing with the situation, provided, of course, that safety considerations admit. Also, it is essential that the gas discharge should be interfered with as early as possible, as the opening periods of the discharge are the most effective.

To ensure an effective and immediate artillery fire the following points require attention:

- aa. Certain Howitzer batteries should be detailed to open a rapid fire for a short time as an anti-gas measure.
- bb. Only certain portions of the enemy's front trenches can be used for gas discharge in any given wind, and these can easily be indicated on any accurate trench map. Each battery charged with the task of hampering an enemy gas attack should be provided with a map and a table showing from what portions of the enemy's lines (within the battery's zone of action) gas can be discharged in any given wind.

For some time past the tendency has been not to follow up a gas discharge with an assault. All the same, the artillery of the defense must be prepared instantly to open annihilating or barrage fire, as the situation may require.

40. *Smoke Barrages.*—A smoke barrage may be employed by the enemy to cover an immediate attack, or it may be fired solely with the object of drawing our fire and thus disclosing the positions of our batteries.

The action of the artillery to be taken in such a contingency must therefore be carefully weighed, for the answers to these two probable reasons for a smoke barrage are directly opposed. The situation at the time must form the best guide. If there is reason to believe that an attack is imminent, annihilating fire should be opened at once, and its instant conversion to barrage fire must be possible. If, on the other hand, there is no reason to anticipate an attack, it will only be serving the enemy's purpose to disclose our artillery positions, and fire should be limited to an endeavour to arrest the smoke discharge by causing casualties to the personnel concerned. At the same time, all artillery should be immediately warned to stand by in case, after all, an attack should develop.

The action of hostile artillery and aircraft should ordinarily contribute to a decision as to the enemy's probable intentions.

XI.—WITHDRAWAL TO REARWARD POSITIONS.

41. *Withdrawal of Batteries**—It is a point of honour with batteries never to retire without orders from a position which they have been detailed to hold to the end. They must be prepared to defend their positions against close infantry attacks by means of their own fire and with the aid of such rifles and Lewis guns as they possess. Should it become apparent that guns will be captured by the enemy and when communication with higher authority is interrupted, artillery commanders must use their own discretion as to whether they will render more assistance to the defence by fighting to the last where they stand or by withdrawing to new positions where they can re-open fire under ordinary methods. In the

latter case, retirement should be made by sections or half-batteries, the first echelon moving to an intermediate position whence the withdrawal of the rest of the battery to its selected position can be covered.

"When it is a question of ensuring the safe withdrawal of the main body, artillery must be ready to take any risk, and loss of material is then fully justified." (F.A.T., Chap. VII., Section 165.2.)

It is to be remembered that, in default of definite orders, the bold policy of holding a battery position to the last will generally pay. For by so doing the enemy's attack may be held up and time be afforded to the infantry of the defence to advance to the assistance of the guns.

Every battery sited for the defence of the Forward Zone must have positions allotted to it for the defence of the Battle and Rear Zones.
[* Movement to an alternative position to cover the same line of defence is not regarded as a withdrawal.]

42. *Disablement of Material.*—The destruction or disablement of material is only justifiable when it is apparent that guns must fall into the hands of the enemy. In view of the fact that it is always to be expected that a decisive counter-attack will restore the situation, it is rarely that resort should be had to the ultimate measure of destruction. Removal of breech-blocks will ordinarily suffice, at least for all guns that are situated in or behind the Battle Zone.

Instructions as to the methods to be employed for the destruction or disablement of ordnance are given in Appendix II.

XII.—AMMUNITION.

43. The storage, transport and supply of ammunition is one of the most difficult problems that confront the successful handling of artillery in defence, and the solution can only lie in thorough forethought and most careful arrangements.

As regards storage, an adequate supply of ammunition must be kept at or near the guns, while a disposable reserve is maintained in Corps and Army dumps. Orders must be issued as to the amount of ammunition to be kept at reinforcing battery positions.

As far as labour and other practical considerations allow, shell proof cover should be afforded for ammunition, at least for cartridges. As a minimum demand, fixed ammunition and separate cartridges must be protected from the effects of the weather. All dumps must be concealed or camouflaged.

In all large gun and mortar dumps arrangements must be made so that one hostile shell shall not result in the explosion of a great part of the ammunition stored. Cartridges especially should be kept in small lots.

Touching transport and supply, it is most important that field tramways should, as far as possible, run right into (and beyond) the battery positions. Supply must be so arranged that by the aid of tramways, lorries and horse-drawn wagons, a continued interruption of traffic by the enemy's fire is impossible.

The control of ammunition at Corps and Army Dumps must be rigorously exercised, and officers in charge must be furnished with definite instructions as to what units they are to supply and their expected and actual consumption of ammunition.

The supply of ammunition to mobile reserves requires special attention, and a careful reconnaissance of the best and safest routes for this purpose is a primary necessity.

APPENDIX I. DIAGRAM ILLUSTRATING THE DISPOSAL OF ARTILLERY IN DEPTH.

Yards	**Enemy's Front Line Trench**
3,000	Close Defence Guns Sniping and Roving Guns Flanking Units and Advanced Sections
4,000	Field Artillery Forward Counter-Battery Artillery
6,000	Second Line of Field Artillery Counter-Battery Artillery Heavy Artillery for Harassing Fire
8,000	Heavy Artillery for Annihilating and Barrage Fire
	Mobile Artillery Reserves

APPENDIX II. DISABLEMENT OF ORDNANCE.

29. For Temporary Disablement.
    - i. By removing essential stores.
      Remove: Breech block; remove sighting gear; all other essential stores.
    - ii. By putting buffers and recuperators out of action.
      Release air pressure, or dent spring cases (with a pickaxe, etc.).
      Remove plugs and buffer nuts.
      Empty buffer.
    - iii. By damaging breech mechanism.
      Cut or mutilate obturator pad (if this exists).
      Damage the vent.

Damage the breech threads. (This will entail repair in a shop.)

30. For Complete Disablement
Release air pressure from recuperator, or dent the spring cases.
Remove plugs and buffer nuts.
Empty buffer.
Lay the gun horizontal.
Place an obstruction in the bore (a).
Load with a round of H.E. (b).
Fire the gun by means of a long lanyard.
    a. In most natures of gun a fuzed shell can be placed nose first down the muzzle.
    b. If a H.E. shell fuzed with a No. 100 fuze is available, remove cap tape and remove steel segments and load with this.

31. When there is a probability that the gun will shortly come into our possession again, disablement should be confined to the removal of essential fittings and stores

33: Extract from the report on the Organization etc. of the IX Corps Artillery during the Operations from 10th to 21st April, 1918; May 1918

Source: Appendix 17 of *OH 1918,* vol. 2
By Brigadier-General G. Humphreys, Commanding Royal Artillery, IX Corps

Grouping

On retirement the trench warfare system of grouping ceased and brigades were commanded as a whole by their own brigade commanders.

Position of batteries of a brigade were kept as close to one another as circumstances permitted so as to simplify communications and the passage of orders.

Retirements

All retirements were carried out in an orderly manner by successive batteries or sections so that fire should be maintained continuously. When a retirement was made, the principle of not retiring till absolutely necessary and of then making as long a one as possible consistent with bringing effective fire to bear on our existing front line was carried out successfully. Batteries or sections often remained in action after the infantry had retired through the guns.

It was impressed on brigade and battery commanders to use their own initiative as much as possible in selection of targets and even, failing communications, on necessity of retirement, but the latter was to be decided only by brigade commanders in default of orders from the C.R.A. or B.G., H.A.

Liaison

When possible the field artillery brigade commander was with infantry brigadier whose front he supported. This was found to be the ideal condition, but, if position of infantry brigadier was an unsuitable one for the field artillery brigade commander to command his batteries from, it was found more advantageous to have an artillery liaison officer with the infantry brigadier. The paramount necessity of the F.A. brigade commander being in personal touch with his batteries, especially during a retirement, was insisted upon.

Batteries did not have permanent liaison officers with battalions as this was considered wasteful and unnecessary under the constantly changing conditions, but whenever the necessity was obvious a liaison officer was provided. The system worked well.

The infantry brigadier, in consultation with the F.A. brigade commander, had full control of artillery covering his front, and batteries or sections could be told off for close support as required. This procedure during a battle of constantly changing conditions is absolutely essential and any effort at centralization of control can only lead to disaster.

Artillery Patrols

Officer's patrols to keep in touch with the infantry situation and the position of the enemy were used with success—notably on April 14th when a patrol sent out by a battery of 19th Divisional Artillery established the fact that our troops were still holding Neuve Eglise, about which considerable doubt existed at the time.

It must be strongly impressed on all artillery officers that they will generally have to depend entirely on their own resources for keeping in touch with the tactical situation.

Forward Observation Officers

The usual field artillery training system of F.O.O.'s was adopted and, owing to favourable ground, observation worked well and at times brilliantly.

Communications

Communication was generally by telephone which on the whole worked well. Visual signalling was often adopted with success and on many occasions runners were used at critical moments and were instrumental in bringing effective fire to bear.

The greatest flexibility in communications is the only way to ensure success. There is no infallible method so every possible means has to be thought out and exploited.

2nd Army Brigade N.Z.F.A. who were in action on 25th Division front report as under:

Serious and unnecessary trouble arose at the outset when Signal personnel manning various Corps Exchanges were found to have decamped apparently on the first news of enemy advance thus denying to regimental troops their reliance on the elaborate system of buried and air lines at a time when most required. It was a common experience both to find these exchanges empty and secondly after communication was established for the exchange to evacuate without warning. If any use of existing systems is to be obtained in above circumstances the control personnel should remain until the last.

I have not been able to ascertain whether other artillery units had similar experience.

Ammunition

At commencement of attack there were 500 rounds per 18-pdr. at the guns—other natures in proportion—and all echelons were full. 100 rounds per 18-pdr. and 4.5" how. were dumped in some rear position.

During moving warfare constant changes of refilling points are necessary and it was considered unwise to have too many rounds at positions and refilling points. It was decided when retirement began that a suitable disposition of ammunition would be about

200 rounds per 18-pdr. and 4.5" how. at the guns. Echelons full.
150 to 200 rounds per gun at refilling point.

The ammunition supply worked smoothly and well.

At no time was any unit dangerously short of ammunition and very little was left behind on the ground on retirement—in nearly every case all dumped ammunition was fired away before retirement took place.

A larger proportion of 18-pdr. H.E. was fired than seems justifiable. I have not been able to go onto the reasons for this exhaustively but it may be accounted for by the considerable proportion of H.E. with 106 fuzes and also that the hilly nature of the ground caused battery commanders to use H.E. when observation was difficult and the angle of sight unreliable.

About 45,000 rounds 18-pdr. H.E. with 106 fuze were used during the 11 days' operations.

The 106 fuze undoubtedly greatly increases the efficiency of 18-pdr. fire at ranges over 4500 yards, but any tendency to use it at medium and short ranges should be checked as its effect in comparison with a well burst shrapnel is necessarily small.

Heavy Artillery

a. Organization of the Heavy Artillery operations is shown in Appendix I. [not reproduced]
b. Directly the attack commenced it was arranged that as far as possible each division should have a proportion of 60-pdrs. and 6" hows. under its orders.

Thus at the beginning of the retirement:

25th Division were allotted	2 60-pdr. batteries
	1 6" how. battery
19th Division " "	2 60-pdr. batteries
	1 6" how. battery

9th Division were given direct control of three 6" how. batteries which were in the H.A. brigade affiliated to the division.

The commander of each H.A. brigade was in close touch with the C.R.A. of Division and acted under his orders.

c. When it became apparent that a retirement would be necessary all natures bigger than 6" how. were withdrawn from action and sent well away to the rear and no effort was made to bring these batteries into action again till the line got more stable. This saved much blocking of roads and complication in ammunition supply.

d. The 6" hows. which were not attached to divisions remained under command of B.G. H.A. whose H.Q. were always as close as possible to all divisional H.Q. B.G. H.A. could therefore keep in close touch with situation and bring an increased fire to bear on any portion of the front which required it.

This system worked admirably under conditions which obtained.

e. On 33rd Division taking over a sector of the Corps front 2 batteries 6" hows., under senior battery commander, were allotted to the division.

On 34th Division coming under the orders of the IX Corps Heavy Artillery support was arranged by B.G. H.A. with batteries under his command.

It was found impossible to allot a H.A. Brigade H.Q. to 33rd Division or specific batteries to 34th Division—in the former case because no H.Q. was available and in the latter case because it would have reduced the batteries remaining under the orders of the B.G. H.A. to a dangerous minimum.

IX Corps H.A. H.Q. kept in close touch with 34th Division and the H.A. support worked smoothly.

f. This system of decentralization of the Heavy Artillery worked well and seems the only practicable one—the constant breakdown of communications making it impossible for the B.G. H.A. to give quick and effective H.A. support to divisions, especially if the front of the corps is at all a wide one.

Control of Fire

g. Control of fire was under Divisions and B.G. H.A. G.O.C. R.A. interfered as little as possible beyond seeing that movements, fire, and use of reinforcements were carried out on proper principles.

Counter-preparatory bombardments and harassing fire by day and night were ordered but their time and amount of ammunition to be used was left was left to the divisions.

h. G.O.C. R.A. or S.O. R.A. visited C.R.A.'s and B.G. H.A. daily and full touch was kept with the situation.

i. Long range harassing fire was kept under Corps control.

Counter Battery

Counter Battery work was only carried out when good targets presented themselves—very little area neutralization was attempted.

When a hostile attack is launched or imminent, the all important target, on which the fire of every possible gun should be directed, is the enemy infantry. This fact appears an obvious one, but I do not think it is perhaps sufficiently appreciated by some heavy gunners who during trench warfare are inclined to get a distorted view of the importance of counter battery work.

During a moving battle I think the C.B.S.O. and his staff can be most usefully employed in organizing a service of information by means of Field Survey posts and counter battery O.Ps. and distributing the information to divisions, etc. By this means he not only performs useful work at the time but also keeps track of hostile batteries with the view of restarting regular counter battery work as soon as the line becomes stable.

Wireless

During the operations one aeroplane was always available for work with the artillery—L.L., G.F. and N.F. calls were the only calls sent.

All masts were installed by H.A. and D.As. [Divisional Artilleries] but owing to misty weather not many calls were sent, though records of some effective L.L., G.F. and N.F. calls were received.

Administrative Arrangements

Report on Administrative arrangements is attached. [not reproduced]

French Artillery

During the latter part of the period under review numerous batteries of French artillery—principally 75-mm. but also 155-mm.—came into action on IX Corps front. No notification of the arrival of these batteries was sent to IX Corps nor were they in any way under IX Corps orders—facts which militated against the most effective use being made of their fire. Immediately the presence of these batteries was detected every effort was made by the use of liaison officers and hastily established communications to employ them to the best advantage and to keep them au courant with the tactical situation.

I am strongly of the opinion that reinforcing artillery should be placed under the orders of the Corps holding the sector, who can then allot them to divisions as required.

Conclusion

j. The whole of the artillery work throughout the period worked well and smoothly and there was no hitch of any sort.

k. Ammunition supply worked particularly well and reflected great credit on the "Q" arrangements and the efforts of the M.T. personnel. It was unnecessary for corps to fix any limit to the expenditure of ammunition.

l. Throughout the period the morale of officers and men remained very high. The men had plenty of food and water and though work was continuous the arrangements for resting personnel were satisfactory and fire very rarely deteriorated from fatigue of detachments. Reports of short shooting were few

34: Fourth Army Artillery in the Battle of Amiens, 26 August 1918

Source: Fourth Army Operations Papers, volume 52, serial 1

1. PLAN OF ACTION.

The decision to forego all bombardment previous to attack was justified by the following considerations :

a. The superiority in morale and skill possessed by our troops over those of the enemy.
b. The comparative weakness of the enemy Artillery and defences generally.
c. Our superiority in the air.
d. The moral and material effect to be derived from the strong force of Tanks placed at the disposal of the Army.
e. The demoralizing effect of a surprise attack.
f. Experience gained in the previous operations of the Fourth Army on the AMIENS front, culminating in those of July 4th.

In conformity with the general plan of action, the concealment of all Artillery preparations became of paramount importance. This involved minute attention being paid to all measures tending to ensure accuracy of fire on the day of attack without previous registration.

The front held by the Fourth Army was approximately 27,000 yds.

The attack was to be delivered on a front of 19,000 yards, expanding gradually to one of 30,000 yards on the final objective.

The depth of intended advance attained in some places 12,000 yards, exclusive of further ground earmarked for the exploitation of success.

The attack was to be delivered by three Corps. On the right, the Canadian Corps was to attack on a three Divisional front of 7,000 yards between the AMIENS - ROYE road and AMIENS - NESLE railway. The action of the First French Army on the right permitted the Artillery of the Canadian Corps to confine its attention solely to its immediate front, but the operations on the right of the Corps were of a somewhat intricate nature necessitating very careful timing of Artillery barrages and bombardments.

In the centre, the Austr. Corps was to attack on a two Divisional front of 7,000 yards between the AMIENS - NESLE railway and the R. SOMME. Its Artillery was afforded a simple plan of action.

On the left, the III Corps was to attack with three Divisions on a front of some 5,000 yards, from the R. SOMME to the north. The Corps was required to establish a strong flank, on the high ground north of the R. SOMME, covering the operations of the Fourth Army generally. Much difficult ground, intersected by woods and ravines, had to be overcome.

The depth of the flank to be formed necessitated the employment of heavy guns to form a protective barrage, and special attention being paid to hostile artillery to the N.E. and outside the zone of attack.

The Artillery of the Fourth Army was reinforced by :

26 Brigades of Field Artillery,
13 Brigades of Heavy Artillery,
3- 6" gun batteries,
1- 12" how. battery

& also by the Horse Artillery of the Cavalry Corps, raising the available Artillery resources to :

52 Brigades of Field, and
26 of Heavy Artillery, with
10 - 6" gun batteries, and
3 - 12" how: batteries, and
3 Brigades R.H.A. of the Cavalry Corps.

The total number of guns and howitzers available was approximately 2000, of which 672 were heavy guns or howitzers. The strength in detail was as follows:

18-pdrs: 954
13-pdrs, RHA.: 36
4.5" hows:: 282
60-pdrs: 144
6" hows:: 336
8" hows:: 90
9.2" hows:: 54
6" guns: 40
12" hows:: 6
12" gun: 1
340-mm. French gun: 1
A. A. guns: 40

18 Brigades of Field Artillery and 9 Brigades of Heavy Artillery were allotted to both Canadian and Austr. Corps, and 16 Brigades of Field Artillery and 8 Brigades of Heavy Artillery were allotted to III Corps.

The Artillery tasks comprised :

g. Barrage fire and the bombardment of strong points and defended localities to cover the advance of Infantry and Tanks.

h. Counter-battery action.
i. Harassing fire on centres of activity, communications, etc.
j. Special Artillery protection of the northern flank. <
k. An advance in force in support of the Infantry advance.
l. Support of the Cavalry exploitation of success.

Normal activity was ordered to be maintained on the front up to Zero. Two factors only were authorised to permit a departure from this procedure. Firstly, the improbable eventuality of a hostile attack in force. Secondly, the possibility of the enemy discovering our intentions and developing a heavy bombardment, more especially with gas shells, on our troops while moving into position on Zero night. In this latter eventuality, orders were issued that all guns available for counter-battery work, without any reservation, on the front concerned, should engage the hostile Artillery and crush it by weight of metal.

2. PRELIMINARY ARRANGEMENTS.

The measures taken to ensure secrecy and surprise may be summarised as follows:

m. Information concerning impending operations was communicated to as few people as possible.
n. Special precautions were taken for the safe custody of all orders and instructions.
o. Misleading rumours were circulated in connection with the concentration of troops.
p. Approach marches and all movements were confined as far as possible to the hours of darkness.
q. Wagon lines, refilling points, etc. were chosen with a view to concealment.
r. All registration and previous bombardment were prohibited except in accordance with the normal Artillery activity existing on the front.

In order to carry out the operations, it was necessary for the Fourth Army to take over some 7000 yards of front from the French, immediately prior to the operations. This necessity added considerably to the difficulties of the Artillery preliminary arrangements to be overcome.

The reinforcing Artillery was concentrated in the area between 31st July and 6th August. It was necessary to site the guns well forward in order to cover the Infantry advance as long as possible, and to bring effective fire to bear on hostile Artillery positions and communications. In some cases this led to minor complications as regards trajectory of shells.

The Artillery already in position was moved forward gradually, some guns being left temporarily in the old positions to maintain the normal Artillery activity of the front.

All new positions were re-sected, bearings taken, and battery boards prepared for the Heavy Artillery by the Topo. Sections.

The incoming batteries occupied positions and dumped ammunition gradually on the five nights previous to Zero. With minor exceptions, due to the late arrival of units, the occupation of positions was completed on the night preceding Zero night.

No work on positions likely to be visible by aerial observation was permitted. Guns were camouflaged and remained silent. Wagon line positions were selected with a view to concealment. The endeavours to conceal all movement by day might have been negatived by the necessity for combining this satisfactorily with the watering of a very large number of horses. Fortunately the weather favoured concealment of movement. Under similar circumstances in future operations, it will be necessary to make elaborate preparations for the watering of horses under cover.

The dumping of ammunition was rendered a severe task by the late arrival of some units, and by the fact that in many cases lorries did not arrive with their units. It was successfully performed, but where it is necessary to prepare for a battle of this magnitude with secrecy and despatch, a large number of extra lorries should be placed at Army disposal to facilitate ammunition arrangements.

The Army Calibration Range proved of great service, a very large number of guns being calibrated behind the line immediately before the operations.

Minute arrangements were made with the object of obtaining accuracy of fire. Those took the form of ensuring the checking of all laying and lines of fire, the testing of sights, etc., immediately before or during the operations.

Stress was laid on the importance of the timely issue of orders, and on the danger of introducing changes into the same subsequent to issue.

Army Artillery orders affecting the operations generally were issued through the General Staff, those of a purely technical nature direct to the Artillery.

The demands for Camouflage material were large, and a big stock should be kept in hand to meet sudden requirements.

Army "Maps" rendered valuable assistance in the production of "Barrage" Maps.

Generally speaking, the preliminary arrangements worked smoothly and well, largely due to the zeal displayed by all ranks and the mutual assistance afforded by units.

For a brief spell, on the III Corps front, the arrangements appeared likely to be jeopardized by a German attack on "X" night, which resulted in the capture of a portion of our front system, but the difficulties created were successfully overcome.

3. BARRAGE FIRE & BOMBARDMENT.

Simplicity of barrage was obtained admirably on the Austr. and part of the Canadian Corps fronts. On both flanks local conditions connected with objectives or irregularity of our front line complicated matters somewhat and necessitated special Corps arrangements.

On the III Corps front, it was necessary to employ 60-pdrs to form a flank protective barrage.

The number of 18-pdrs available afforded a barrage of 1 gun to 25 yards approximately.

The general arrangements for barrage fire were as follows:

The 18-pdr barrage fire came down 200 yards in front of the Infantry taped line at Zero. All lifts were of 100 yards. The first lift was timed for Zero plus 3, the second for Zero plus 5, and the next 8 lifts at 3 minutes interval. Subsequent lifts were at 4 minutes interval. The barrage was timed to reach the first objective in about 2 hours, and a protective barrage was maintained until Zero plus 4 hours, when all barrage fire ceased.

The 4.5" barrage moved in advance of that of the 18-pounders.

In view of the nature of the ground, which was hard and comparatively free from craters, and of the weak nature of the hostile defences, it was left to Corps to employ either 18-pdr. shrapnel or H.E. with delay action fire for barrage purposes. Canadian and III Corps employed shrapnel; the Austr. Corps shrapnel and H.E.

Use was made of smoke shells locally, both for barrage purposes and to form smoke screens.

The barrages were remarkable for their accuracy.

The deciding factors in the nature of barrage to employ, as also in its rate of advance, are those of nature and state of ground and defences to be overcome.

Shrapnel may be regarded as efficacious under all circumstances of ground, and its advantages are pronounced on heavy shell-pitted ground. It is unmatched as a man-killer against troops in the open, but has not the same demoralizing effect as H.E. The difficulties connected with adjustment of height of burst lead to a somewhat large percentage of rounds being burst on the ground, where they are generally ineffective, or too high in air; moreover, the error introduced by the time of burning of the fuze, more especially at long ranges, makes a time shrapnel barrage compare unfavourably in accuracy and simplicity with that of H.E.

H.E. with non-delay fuze is very suitable on hard ground, provided the slope of ground is not unfavourable. It is very effective against entrenched troops. Infantry can advance very close under it without undue risk of casualties. It is not effective and should not be employed on soft or shell-pitted ground nor at long ranges.

H.E. with instantaneous fuze was not employed on this occasion, but affords an effective substitute for H.E. with delay action fuze on soft or shell-pitted ground, and is the only shell which can be relied on as effective at long ranges.

In employing H.E. generally, it must be remembered that the zone of dispersion is outwards and somewhat forward; there is but little back-blast.

10% of smoke shells forms a suitable proportion for barrage purposes.

In view of the nature of the enemy's defensive system, the fire of most of the Heavy Artillery, other than that employed for Counter-Battery work, was directed on strong points and localities, being timed to lift according to the advance of the Infantry. Roads and communications in the forward area were dealt with chiefly by 60-pdr fire.

For the later stages of the operations, lines of demarcation for Heavy Artillery fire, based on the probable progress of the Infantry, were laid down.

4. COUNTER-BATTERY WORK.

As the hostile Artillery was regarded as the chief menace to the attack, two-thirds of the available Heavy Artillery was allotted to deal with it. At Zero, the whole of this Counter-Battery Artillery opened fire on a pre-arranged programme. H.E. and 106 fuze were employed almost exclusively, except on the III Corps front where gas shells were used in addition against the batteries lying outside the intended zone of advance.

The German Artillery fire was rendered almost negligible.

Careful arrangements had been made for the continuance of vigorous Counter-Battery work in the latter stages of the offensive, but as the enemy's gun positions were practically all over-run, there was comparatively little scope for it, except on the III Corps front.

Before the attack, the enemy's Artillery strength was computed at about 680 guns. As a proportion of these lay outside the zone of operations, north of the SOMME, and the captures amount to some 450, but few can have succeeded in retiring.

An examination of the gun positions was of great interest. The positions generally were well concealed, and natural cover was made good use of, but very little artificial protection against shell fire was afforded. The ammunition was generally scattered in small dumps at and in the neighbourhood of the guns. It was placed in gun pits behind banks, in trenches, or in shell craters, according to local conditions, and camouflaged over.

As a rule, bomb-proof cover was not provided for the detachments at the gun positions.

Some guns had been hit and some dumps of ammunition blown up, but generally the damage caused to equipment and ammunition was comparatively small, in spite of the evident accuracy of the fire.

In the majority of cases, the detachments had evidently either been driven from their guns or had failed to man them. Some guns were captured with camouflage material over them and muzzle and breech covers still on. Where attempts had been made to keep the guns in action or to limber up, the havoc wrought amongst personnel and horses was generally great, and afforded excellent testimony to the accuracy of the fire and the destructive effect of the shells.

The destructive effect of Artillery fire, unless the enemy is manning his guns or replenishing ammunition, is always likely to be small.

We require, firstly, to concentrate all the means at our disposal towards the accurate location of the enemy Artillery positions, and secondly, to register carefully the positions so determined. It then remains to direct sudden and overwhelming concentrations of fire on the positions thus located and registered. This is the form recommended for pre-arranged destructive shoots.

In addition to this, our Counter-Batteries should be capable of concentrating their fire rapidly on hostile Artillery in response to the indications of aeroplane, balloon or ground observers. This is the form that impromptu destructive shoots should take.

The interior mechanism of this system, and the times and places for its application form a vast field of enterprise for all concerned, more especially for Counter Battery Staff Officers. The system is equally applicable to dealing with camps—villages—and centres of activity.

5. LONG RANGE GUN WORK.

A map was issued by the Army indicating the special localities, bridges, railheads, etc., which were to be kept under fire by the 6-inch guns under the direction of the Corps.

6. ADVANCE OF THE ARTILLERY.

Minute arrangements were made for pushing forward Artillery as soon as possible after Zero. Roads and tracks were allotted, and preparations made for bridging trenches rapidly. A few units were held mobile from the start, but the majority detailed to advance joined in the barrage and subsequently limbered up to advance at pre-determined times.

The Artillery may be said to have advanced in waves. First of all, Brigades under orders of Divisions, with Sections pushed out to the front. Then a limited number of 60-pdrs, and in the case of the Canadian Corps some 6" howitzers, since this Corps possessed fortunately two 6" howr. horse-drawn batteries. These were followed by further Brigades of Field Artillery. The remainder of the Field and Heavy Artillery moved up subsequently under Corps orders. The change in command from Corps to Divisions, and subsequently the resumption of command by Corps, worked smoothly. A special point was made of pushing forward the 6" guns as early as possible in order to shell the approaches and bridges over the SOMME.

The whole advance of the Artillery may be described as very successful. At the same time instances were not wanting to indicate the necessity of combined training in open warfare.

Experience points to the increased importance to be attached to pushing forward Sections in the immediate support of Battalions and Tanks. Unless they are pushed well forward, they are not likely to be available when required.

It is sufficient to attach one battery of 60-pdrs and one battery of 6-inch howitzers under a Brigade Commander R.G.A. to a Division. These should be placed under the orders of the C.R.A. of the Division. A larger force of Heavy Artillery becomes somewhat unwieldy for the Division to handle in moving warfare.

Many units carried portable bridges, and a few made use of them. They are not considered essential, but if not carried, ample provision should be made to carry tools. Material assistance was rendered to the Heavy Artillery of one Corps by the attachment to it of R.E. personnel and this procedure is recommended strongly.

7. R.H.A. AND CAVALRY.

Each Cavalry Brigade was accompanied in its advance by its own battery. R.H.A. Brigade Commanders remained with the Cavalry Divisional Commanders, acting as Artillery advisers. Every gun went forward with three ammunition wagons, i.e., 252 rounds in all. The moral effect produced by a few rounds fired against machine guns and local counter-attacks is reported as remarkable. The importance of pushing the R.H.A. guns well to the front, and handling them with great boldness, was demonstrated. Guns which were kept back proved of but little value, as the opportunity for their successful use quickly passed away.

8. ARTILLERY & TANKS.

Experience tends to show that Artillery support is as important to the Tank as it is to the Infantry. If Infantry move forward without the protection of barrage fire, they become a prey to machine guns. If Tanks excursionize out without Artillery support, they are liable to fall victims to a single gun. So long as they remain under the protection of the barrage, but little ill befalls them. In moving warfare it is just as essential to push forward sections of Artillery in the close support of Tanks as it is of Infantry Battalions.

9. 6" TRENCH MORTARS.

On the fighting front only one Corps (Canadian) made an extended use of 6" Trench Mortars. These were employed as follows:

s. 12 mortars were equipped as mobile units and advanced with the Infantry. The transport for the Mortars, and for a limited number of rounds of ammunition, was generally an adaptation of the limbered G.S. wagon, each Division having its own pattern. Improvised beds of a lighter pattern than the usual bed were also provided, these again varying according to the Division. Additional ammunition was carried forward in limbered G.S. wagons, G.S. wagons of D.A.Cs., and, in the case of one Division, in Supply tanks.

t. Two 6" Trench Mortars of 5th Canadian Division were specially mounted on a 3-ton lorry in such a way that they could be fired from the lorry or removed and fired from the ground in the ordinary way. These two mortars accompanied the "Independent Force," which consisted of two Canadian Motor Machine Gun Brigades and the Canadian Corps cyclists.

One Mortar accompanying the Infantry was knocked out by a direct hit early in the day. The remaining 11 succeeded in keeping in close touch with the Infantry. They engaged numerous machine gun nests, etc., which were holding up the advance and in this way were of the greatest assistance.

In every case in which a strong point was engaged by a Mortar, the enemy cleared off after a few rounds had been fired.

The two Mortars with the "Independent Force" also did useful work. They fired 50 rounds, and on occasion claim to have silenced an enemy Field battery.

10. A.A. ARTILLERY & SEARCHLIGHTS.

At Zero hour the Anti-Aircraft guns were disposed:

1 section of each battery 1000 yards to 2000 yards behind the START line.

1 section of each battery in the "Balloon" zone.

The remaining sections covering rear areas.

The orders for the advance were:

Front section of each battery to advance as close as possible behind the Infantry.

Sections in "Balloon" area to advance with the balloons.

Rear sections to await further orders.

The above orders were carried out according to plan, and by the afternoon of 8th August, two sections of each battery were in action in the captured area, except on the northern flank where the depth of the advance was not great enough.

During 8th August, enemy aircraft showed little activity, and were dominated by our aeroplanes.

176 E.A. [enemy aircraft] were seen, of which 90 were engaged, although only 16 are reported to have crossed our lines.

On August 9th and 10th, enemy activity increased, the number of machines seen being 263 on 9th and 305 on 10th.

Between August 8th and August 14th, both dates inclusive, 7 enemy aeroplanes were crashed by A.A. fire and one damaged.

After August 8th, hostile bombing activity became marked in the forward areas—more especially at night. This was to a large extent negatived by pushing forward searchlights. In future operations, arrangements should be made to push these forward on the first day of operations.

11. FIELD SURVEY UNITS.

The Corps Topographical Sections, assisted by topographical personnel from the Field Survey Battalion, resected all battery positions not already occupied, worked out centre lines to correspond with the tasks allotted to the various batteries, and in many cases provided map boards. The thoroughness with which this work was carried out assisted materially in enabling accurate barrage and counter-battery fire to be opened without previous registrations.

The Observation Groups moved forward on the day of battle, and from then on kept pace with the advance of the Heavy Artillery. It was found that the church towers and other buildings in the villages in the captured territory provided excellent flash spotting O.Ps. and these were made full use of.

The Sound Ranging Sections advanced on August 8th, and by the 10th had established bases covering the old AMIENS defence line. On August 12th it was decided to advance the Sound Ranging Sections further, and by the 15th they had their bases established to cover the new front.

The accuracy with which the work of Field Survey units was carried out prior to the operations and the promptness with which the Sound Rangers and Flash Spotters were established on the new line proved of the greatest assistance to the Artillery in carrying out their tasks.

12. ROYAL AIR FORCE.

The morning of 8th August was misty, and visibility remained indifferent until late in the day.

Very few 'NF' calls were sent, as the German batteries were soon overrun, but many 'GF' calls were sent and received.

In the Canadian Corps a special contact aeroplane was sent out to keep Divisions informed of the situation of their Field batteries. Batteries were provided with special panels to show:

u. The number of the battery.
v. The amount of ammunition in hand.
w. Whether the battery was in possession of a wireless mast.

The information was conveyed to the Divisions by means of messages dropped at Divisional dropping Stations.

There had not been time to equip all batteries with the special panels.

Some messages were dropped at the wrong stations by mistake.

Although the system was not perfected, it enabled Divisions to receive useful information earlier than they would have done otherwise. The system is one which merits attention with a view to future operations.

13. BALLOONS.

The system on which the advance of balloons was directed was:

On III Corps front, balloons worked 1000-2000 yards in advance of normal positions.

On Canadian and Australian Corps fronts all balloons were inflated before Zero, but were not then moved to forward positions owing to the prospect of visibility being much obscured and to the danger of their being knocked out by chance shots before they could do useful work.

Balloons were indicated the places which they were expected to reach at stated times. These advances, amounting in some cases to 10,000 yards, were successfully carried out, and by 3.0 p.m. on August 8th, the front was under observation by balloons at normal distances from the line.

14. COMMUNICATIONS & INFORMATION.

The depth of the advance on August 8th made the upkeep of communication by telephone a matter of great difficulty, and reliance was placed chiefly on visual signalling and C.W. Wireless Sets.

The country lent itself well to visual signalling, and this form of communication was extensively and successfully used, lamps being the principal means employed.

C.W. Wireless Sets were used with success on Canadian and Australian Corps fronts; the amount of information received through this means was limited by:

x. All messages having to be coded and decoded.
y. Only about 2 stations could work to the central station of a

Divisional front owing to jambing.

One point brought out in these operations is that although the higher formation is responsible for upkeep of communication to the next lower formation, the latter must keep the former informed of intended moves, and must continue to send information back to their old Report Centre for transmission until the higher formation has established communication to the new Headquarters of the lower formation.

Failure to take these precautions led to one Brigade of Artillery being out of touch with its Divisional R.A. for the greater part of the day.

The following arrangements were made for passing Artillery information back:

Each Corps R.A. had direct lines to Divisional Artilleries and Corps H.A.

A Liaison Officer was established at each Corps R.A., H.Q., to transmit information direct to Army R.A. These Officers were given authority to send "Priority" telephone messages.

By these means information was quickly transmitted to Army H.Q.

15. THE USE OF CAPTURED GUNS.

Provision for the use of captured guns was made in preliminary orders and instructions. Parties were detailed to proceed to hostile battery positions as soon as these were captured; these parties were taken in some instances from batteries not under orders for an early advance while in other cases they were found from Trench Mortar personnel. All available information as regards types of guns and howitzers, range tables etc., was circulated beforehand.

Many of the captured guns were found to be deficient of sights or other essentials, but sufficient pieces were found complete to enable a considerable number to be used against the enemy.

In several instances valuable assistance was afforded the Infantry by turning the fire of captured guns on to localities which were temporarily holding them up. Unless the personnel to man the guns accompanies the Infantry the fire of the guns is likely to be masked.

As in the case of Mobile Trench Mortars, it was found that a few rounds were sufficient to break down the enemy's resistance and to enable the Infantry to push on.

During the course of these operations, many valuable documents were captured in the form of up-to-date Range Tables, handbooks, etc; it is suggested that the information so obtained should be widely circulated in pamphlet form. It is also suggested that instruction in German Artillery equipment should in future form part of the course at Artillery Schools.

16. WORKSHOPS.

One of the advantages of an attack carried out without previous bombardment is the high percentage of guns which are available for the day of battle. On August 8th, 98.5% of the Artillery strength was so available.

Practically no extra workshops were required beyond those accompanying normally the Canadian Corps.

The advance of Workshops commenced on the day of battle. Those that first went forward acted more as Store Shops than Workshops.

The advance of Workshops should be conducted in "leap-frog" fashion, those furthest to the rear being held mobile to move forward as soon as success is assured.

17. AMMUNITION SUPPLY.

It is essential to have a "pool" system of lorries in Corps, permitting—under Corps orders—of supply lorries being used in an emergency for ammunition purposes and vice versa. This in no way prohibits Siege Park lorries being under the orders of the C.H.A., but merely legislates for the lorries under his command being available for general purposes if not required for those of the Artillery.

It is necessary to call attention to the importance of the lorries of the Artillery detailed for a concentration for battle, firstly, being fit for work, and secondly, arriving with their units. In both these respects arrangements were not altogether satisfactory.

For an advance it is essential to exercise the closest supervision over ammunition supply, more especially as regards the clearance of ammunition from vacated positions, if prohibitive waste is to be avoided. The arrangements of the Australian Corps worked excellently and some useful remarks on this subject by the G.O.C., R.A. of that Corps are added as an Appendix to this paper. [not reproduced]

The dumps of ammunition authorised by the Army were as follows:

18-pdr: 600 rounds per gun.
4.5" how: 500 rounds per gun.
6" how:)
8" how:)
9.2" how: 400rounds per gun.
60-pdr Gn)
6 " gun)
12 " how: 200 rounds per gun.

In addition echelons were kept full.

The number of rounds dumped erred somewhat on the large side, even allowing for the necessity which always exists to legislate for possible eventualities.

If special ammunition is required in large quantities—such, for example, as H.E. with delay action fuze for barrage purposes—ample warning must be given, as it is otherwise not practicable to adjust ammunition supply satisfactorily.

18. EXPENDITURE OF AMMUNITION.

The total expenditure of ammunition on the Army front was:

August 8th: 448,953 rounds.
August 9th: 170,625 rounds
August 10th: 203,254 rounds
August 11th: 109,361 rounds

The expenditure in detail on August 8th was:

18-pdr.	Shrapnel:	153,356)
	H.E.:	113,764)
	Smoke:	12,577)
	Total:	281,697
13-pdr.:)	Total:	about 7,000
4.5" How:	H.E.:	54,953)
	Smoke:	5,259)
	Gas:	288)
	Total:	60,500
60-pdr.	H.E.:	15,010)
	Shrapnel	12,617)
	Total:	27,627
6" Gun.	H.E.:	2,269)
	Shrapnel:	1,667)
	Total:	3,936
6" How:	H.E.:	54,926)
	Gas:	2,403)
	Total:	57,329
8" How:	Total:	10,576
9.2" How:	Total:	6,553

12" How:	Total:	369
12" Gun.	Total:	26

The average number of rounds per gun fired on August 8th was:

	Army	**III Corps**	**Australian Corps**	**Canadian Corps**
18-pdr.	301	200	360	330
4.5" How:	214	140	300	200
60-pdr.	177	180	230	140
6" Gun.	102	46	170	100
6" How:	165	160	270	130
8" How:	98	110	90	100
9.2" How:	109	100	130	100

The economy in ammunition expenditure realised by the absence of preliminary bombardment is enormous.

19. CASUALTIES.

z. Personnel. On August 8th the Artillery battle casualties were:

	Officers	**O.R.**	**Total**
Killed	3	23	26
Wounded	13	89	102
Missing	—	1	1
Gassed	—	—	—
Totals	16	113	129

aa. This probably consitutes [sic] the smallest casualties on record for a battle of this magnitude, embracing moreover an advance by the Artillery in force.

bb. It is a remarkable fact that during the operation of July 4th resulting in the capture of HAMEL, VAIRE WOOD, etc., and 1500 prisoners, the casualties of the Heavy Artillery of the Australian Corps were 1 man wounded (accidentally). On August 8th the casualties of this Artillery were NIL.

cc. The total Artillery casualties on the three days following the attack were:

Killed	71
Wounded	411
Missing	146

Gassed	1
Totals	629

dd. On the night of August 7th/8th, while moving guns into position on the III Corps front, the Artillery incurred gas casualties to 18 Officers and 117 other ranks, of which 16 officers and 104 other ranks were in one Brigade.

ee. A large proportion of such casualties as there were on August 8th and subsequent days were due to bombing.

ff. Horses. The casualties to horses on August 8th, 9th, 10th and 11th amounted to 1,030, of which 720 were due to bombing. Two small bombs inflicted casualties to no less than 212 horses, which were bunched together in the LUCE Valley.

gg. Equipment. The casualties to equipment from hostile shell fire or bombing were:

	Field Artillery	**Heavy Artillery**
August 8th	11	—
August 9th	6	—
August 10th	—	—
August 11th	—	—

hh. The smallness of these casualties contrasted with those of previous battles are no less striking than those suffered by the personnel. (d) The official report of D.M.S. [Director of Medical Services], Fourth Army states:

ii. "During recent operations on this Army front, it has been noticed that there were very few cases of shrapnel wounds among British troops, about 7-% being rifle and machine gun bullets and about 27% shell wounds.

jj. "On the other hand, the wounds among German wounded prisoners show an exceptionally high percentage of shrapnel wounds."

kk.

20. GENERAL REMARKS.

ll. The overwhelming success of the operations of the Fourth Army resulting in the capture of over 22,000 prisoners and 400 guns and in the liberation of AMIENS, has not prevented one from endeavouring to point out weaknesses in the Artillery arrangements, from which useful lessons may be derived for the future. Progress should be looked for especially in connection with:

- i. Combined training of Artillery with Infantry, Tanks and Royal Air Force.
- ii. Ammunition supply.
- iii. Improvement and use of 6" Trench Mortars.

It is permissible, however, in this case to state that more useful lessons may be drawn from a study of the causes of success than from those of defects.

As this is an Artillery screed, one can but state that pride in the achievements of the

Artillery does not blind one to the incomparable part played by our Infantry in this battle, nor yet to the magnificent support rendered to them, as also to the Artillery, by Royal Air Force, Cavalry and Tanks alike.

From an Artillery point of view, the factors in the success which strike one principally are:

iv. The advantages gained by a surprise attack.
v. The advantages of the permanent Corps system, resulting in a clearly defined Artillery policy and plan of action in the Corps.
vi. The success of the Artillery in surmounting difficulties in the preliminary arrangements, in which the great assistance of "Q" must be gratefully acknowledged.
vii. The energy and zeal shewn in the advance of the Artillery early in the battle.
viii. The accurate location of hostile Artillery positions previous to battle.
ix. Last but not least the spirit of co-operation which united Artillery and Royal Air Force, including Balloons, Observation Groups, Sound Ranging Sections, and Workshops in their united efforts to assist the Infantry by rendering effective the fire of the Artillery.

[signed C.E.D. Budworth]
Major General.
G.O.C. R.A., FOURTH ARMY.

H.Q., R.A.,
FOURTH ARMY.
26th Aug. 1918

35: Fourth Army Artillery in the Attack on the Hindenburg Line, c. October 1918

Source: Fourth Army Operations Papers, volume 52, serial 2

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1. THE ENEMY'S POSITION.

2. PLAN OF ATTACK.

3. STRENGTH & ALLOTMENT OF ARTILLERY AT ZERO.

4. DISPOSITIONS BETWEEN 27th & 29th SEPT.

5. DUMPING OF AMMUNITION.

6. PRELIMINARY BOMBARDMENT.

7. ARTILLERY ACTION ON 29th SEPT & SUBSEQUENT DAYS.

8. RESULT OF THE OPERATIONS.

9. AMMUNITION EXPENDITURE.

10. CASUALTIES TO PERSONNEL.

APPENDICES.

A. MAP SHEWING ARTILLERY DISPOSITIONS, SEPT 26th. [not reproduced]

B. MAP SHEWING ARTILLERY DISPOSITIONS, SEPT 29th. [not reproduced]

C. MAP SHEWING ARTILLERY DISPOSITIONS, OCTR 4th. [not reproduced]

D. EXTRACTS FROM "INSTRUCTIONS FOR OPERATIONS", (FOURTH ARMY NO. 273 (G))

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1. THE ENEMY'S POSITION.

The HINDENBURG Line, to which the Germans had retreated after 1 _ months' continuous fighting, was a position of great natural strength, chosen deliberately and sited skilfully.

It had been fortified thoroughly in 1916 and 1917, and was provided plentifully with all known artificial aids to defence such as wire, trenches, dugouts, etc.

The defences had not been kept in perfect repair, but cover and protection were ample.

A formidable Outpost Line, which had been defended successfully in 1917, covered the main position. This line was sited well for observation, and comprised an elaborate network of trenches and strong points protected by wire, thrown well forward from the main defensive position, and possessing many covered approaches.

The maintenance of this outpost line was essential to a prolonged defence of the HINDENBURG Line, since its loss facilitated enormously the task of an assailant's Artillery.

On the greater part of the FOURTH ARMY front, the ST. QUENTIN-ESCAUT Canal provided a formidable obstacle immediately in front of the main line of defence. Special pains had been taken to fortify the two open stretches (LE TRONQUOY-LEHAUCOURT and BELLICOURT-LE CATELET), where the Canal runs underground. The two canal tunnels running under these stretches are respectively 1,200 yards and 6,200 yards in length.

In addition the enemy had constructed the BELLENGLISE-MAGNY LA FOSSE tunnel, 2,000 yards long and furnished with numerous lateral shafts, which was capable of affording shell-proof protection to at least a Division.

Some factors which made lighter the formidable task of breaking through the HINDENBURG Line were:

a. Although the Germans had plenty of men to man the defences, the Divisions opposed to the Fourth Army had all been beaten in the previous fighting.
b. The German Artillery and Air Services were markedly inferior to our own.
c. We had learnt the general plan of defence from captured documents.
d. The capture of the German outpost line West of the Canal gave us observation over the main line of defence and prevented the enemy from overlooking our back areas. The enemy fought hard for this line, and its capture was not absolutely complete on 28th Sept.

2. PLAN OF ATTACK.

The general plan of attack was as follows:

v. The IX Corps to attack the Canal front from 500 yards S. of BELLENGLISE to the junction of the ESTREES-LE CATEAU and ST QUENTIN-BELLICOURT Roads on a one Division front. Frontage of attack 3,000 yards.

vi. The II American Corps to attack the high ground between BELLICOURT to a point W. of LE CATELET (i.e., the tunnel portion of the Canal). Frontage of attack 6,000 yards.

On the II American Corps reaching its objective, the Austr. Corps to pass through and secure the Final Objective for the day.

vii. The right Division of the IX Corps on the South, and the III Corps on the North to conform to the main attacks and to form defensive flanks.

3. For STRENGTH & ALLOTMENT OF ARTILLERY AT ZERO - SEE App. "D", para.4(b)

The total of Guns and Howitzers amounted to:

13 pdrs. — 18
18 pdrs. — 786
4.5" How. — 240
60 pdr. — 120
6" How. — 292
8" How. — 78
9.2" How. — 56
12" How. — 8
6" guns. — 36
12" guns. — 1
14" guns. — 1

TOTAL FIELD ARTILLERY — 1,044
TOTAL HEAVY ARTILLERY — 592

4. DISPOSITIONS BETWEEN 27th & 29th SEPT.

At the commencement of the preliminary bombardment, the Artillery was sited as shewn on attached map "A".

During the period 26th-28th Sept there was severe fighting on both flanks of the Army front in order to gain the "Start" Line. This fighting necessitated the moving of many batteries during the period covered by the bombardment.

At Zero hour on 29th Sept the Artillery was sited as shewn on attached map "B".

5. AMMUNITION.

For Ammunition dumped, see Appendix "D", para.4 (n).

The task of completing the requisite dumps was made difficult by the fact that fighting was in progress during the preliminary period. This caused heavy expenditure from day to day, and also entailed the moving of many batteries, thus reducing the number of lorries available.

Additional difficulty was caused by the unavoidable late running of trains on the newly opened line. As many as 15 trains had to be cleared in one day, as well as the transference of large amounts by lorry from the Army Reserve Dump.

These difficulties were successfully overcome, and at Zero hour on 29th Sept the dumps at the guns were as laid down approximately.

6. PRELIMINARY BOMBARDMENT.

For Orders and Instructions, see Appendix "D", paras 4 (e), (f), (g), (h), (i), (j).

h. SPECIAL GAS 'BB' BOMBARDMENT.

The bombardment was carried out according to orders, a total of 26,101 18pdr and 6,236 6" Howr. 'BB' shells being fired.

This bombardment was of special interest as constituting the first occasion on which 'BB' shells were employed by British Artillery. [BB was the British letter code for 'mustard' gas.]

The bombardment was spread over a wide area, Headquarters, communications, and some groups of batteries being the principal objectives.

A large number of prisoners from all Divisions in the line were examined with the object of ascertaining the effects caused by the bombardment. The evidence obtained indicates a wide distribution of casualties, there being a steady dribble of gas cases during the morning of the 27th. There is no good evidence supporting very heavy local losses. The group of batteries in and around LEHAUCOURT, which had been located accurately, appears to have been silenced effectively.

Our troops traversed on September 29th the ground which had been shelled some 50 hours previously, without inconvenience.

i. COUNTER BATTERY WORK.

Owing to atmospheric conditions curtailing photography and observation, the positions of hostile batteries were not located with as much accuracy as on some previous occasions, but the German Artillery was dealt with effectively, and caused but small loss to our troops. Subsequent examination of hostile positions revealed a good percentage of direct hits on equipment and of ammunition blown up. The enemy had been forced to a wide distribution of units and of guns. In several cases guns were captured which had evidently not opened fire.

j. HARASSING FIRE.

The evidence of prisoners on the effects of this fire is convincing. Rations were cut off; communications interrupted; reliefs prevented from coming up; and heavy casualties were caused. The total result was to bring about disorganization and loss of morale, the effects of which bore their fruits on the day of battle.

k. WIRE CUTTING.

In many places the wire was damaged seriously; in some places lanes were cut through it; and, in a few places, it was swept away.

Generally speaking, it was not due to effective destruction of wire defences—such destruction indeed was outside the power of Artillery, given the nature of the defences—but to the demoralization of the enemy and to effective Artillery covering fire, that our troops were enabled to penetrate the wire defences. The enemy, presumably owing to the demoralization wrought by our Artillery fire, failed to fill up gaps and passages in the wire which he had made at some previous period.

l. BOMBARDMENT OF SELECTED STRONG POINTS & LOCALITIES.

The preliminary bombardment of 48 hours was justified fully by the moral effect caused, nor was destructive effect to material and personnel wanting.

As was only to be anticipated, the use made of enfilade fire proved particularly effective, while the effects of special concentrations of fire, such as that on the BELLENGLISE Salient, were overwhelming. The destruction of the tunnels and deep dugouts were beyond the powers of the Artillery and was not attempted.

Severe damage was caused to the front and support lines east of the Canal. Some of the entrances to mined dugouts were partially blocked. The walls of the Canal were hit at frequent intervals, and banks of debris formed, up which the attackers could scramble. Many of the specially defended localities were rendered mere heaps of debris.

Provided as he was with secure shell cover, the enemy's losses in killed from the bombardment were probably not great. Losses, however, were inflicted, a good example being furnished by a 6" Howr. shell with delay action fuze, which penetrated into a small chamber used as a kitchen at the southern end of the BELLENGLISE Tunnel, killing 13 men and wounding 10.

The great result of the bombardment was that the defenders were driven into their deep dugouts, and so demoralized that to a large extent they failed to man their defences on the day of attack.

7. ARTILLERY ACTION ON THE 29th & SUBSEQUENT DAYS.

The results of our Artillery fire as a death-dealer and as a life-saver are written on the ground and in the trenches by German corpses and unused rifles and ammunition. Special examples of the man-killing effect of Artillery fire were conspicuous, amongst other places, at USIGNY Dump—a strong point for machine guns. Here lie over a hundred German dead, killed by artillery fire whilst drifting to the rear.

Near RAMICOURT are clearly depicted the results of a German endeavour to reinforce the firing line under hostile artillery fire.

At MONTBREHAIN, a good example exists of the destruction of the machine gun strong point and its defenders, while near by trenches and surrounding ground are strewn with dead.

Numerous other instances can be cited, but a few extracts from prisoners' statements will suffice.

"Prisoners state that our 48 hours bombardment prior to the attack was extremely effective, and that it was owing to this that the pioneers of the 2nd Division were unable to blow up the bridges over the canal at BELLENGLISE, as they did not receive food for two days and dared not leave their dugouts owing to the artillery fire."

"The men of the 75th Machine Gun (Marksmen) Detachment, after suffering casualties from our artillery fire, retired to their dugouts and waited for our Infantry in order to surrender."

"2nd Battn, 33rd Regt. (2nd Division) was in reserve at MAGNY LA FOSSE, and was ordered to go forward and reinforce, but was unable to do so owing to our artillery fire."

The advance of the Artillery was carried out successfully, according to programme in spite of the difficulties caused by the limited number of crossings over the Canal, the wired nature of the country, and congestion of traffic on the roads.

8. RESULT OF THE OPERATIONS.

The immediate result of the operations was the capture of the HINDENBURG Line from LE TRONQUOY to VENDHUILLE, with the Villages of THORIGNY, LEHAUCORT, LE TRONQUOY, BELLENGLISE, MAGNY LA FOSSE, ETRICOURT, NAUROY, LEVERGIES, JONCOURT, SEQUEHART, BELLICOURT, BONY, LE CATELET, BOUY, VENDHUILLE, over 14,000 prisoners, and 110 guns.

To the south and to the north a path was opened for the advance of the First French and Third British Armies, resulting in the fall of ST. QUENTIN and CAMBRAI. The victory gained inflicted one of the heaviest blows which German prestige had sustained throughout the whole war. It is not yet possible to estimate at its full value its influence on the minds of German Military leaders and Government.

9. AMMUNITION EXPENDITURE.

The expenditure of ammunition during the period noon 26th Sept to noon 4th October was :

13 pdrs. — 19,802
18 pdrs. — 735,130
4.5" How. — 179,555
60 pdr. — 90,418
6" How. — 210,142
8" How. — 29,974
9.2" How. — 21,043
12" How. — 1,857
6" guns. — 11,546

TOTAL FIELD ARTILLERY — 934,487
TOTAL HEAVY ARTILLERY — 364,980
GRAND TOTAL — 1,299,467 Rounds.

10. CASUALTIES TO PERSONNEL.

The casualties to personnel in the Artillery for the period noon 26th Sept to noon 4th October were:

	OFFICERS	**OTHER RANKS**
Killed	8	94
Wounded	40	576
Gassed	9	131
TOTAL	57	801

GRAND TOTAL — 858

[signed C.E.D. Budworth]
Major General.
G.O.C. R.A., FOURTH ARMY.

Headquarters R.A.,
FOURTH ARMY.
23rd October 1918.

APPENDIX "D".

EXTRACTS FROM "INSTRUCTIONS FOR OPERATIONS"
(FOURTH ARMY No. 273(G), DATED 23rd Sept.1918.

4. ARTILLERY.

m. PRELIMINARY BOMBARDMENT.

The bombardment will commence at 10.0pm, 'W' day, and will be continued until Zero hour 'Z' day.

n. ALLOTMENT OF ARTILLERY.

The following will be the strength of the Artillery placed at the disposal of Corps:

	Field Arty			**Heavy Arty Bdes.**					**Siege Btys.**	
Corps	D. As.	Army Bdes.	Total	Mobile	8"	9.2"	Mixed	Total	6" Gun	12" How.
III	3	—	6	—	1	—	2	3	2	1
Aust.	7	9	23	3	3	2	2	10	4	1
IX	4	7	15	1	3	2	2	8	3	2

o. BOUNDARIES.

Boundaries between Corps as regards bombardment and counter-battery work coincide with those between Corps on map issued with Fourth Army No. 20.23(G) dated 22.9.18. [Not attached].

p. The bombardment will consist of :

- a. Special gas (BB) bombardment.
- b. Vigorous counter-battery fire.
- c. Intensive harassing fire.
- d. Cutting lanes in hostile wire defences.
- e. Bombardment of selected strong points & localities.

q. SPECIAL GAS (BB) BOMBARDMENT.

This bombardment will be carried out by 18-pdrs and 6" hows. firing BB gas shells in combination with H.E. during intermittent periods between 10.0pm on 'W' day and 6.0am on "X" day. Captured German guns firing yellow cross shells will be employed as far as circumstances permit.

The objectives will be the hostile defensive system and Artillery positions along the whole front so far as the range of guns permits. Arrangements will be made with the French to extend the front of bombardment on the right.

Subsequent to 6.0am 'X" day, no BB gas shell will be fired without the authority of the Army.

r. VIGOROUS COUNTER BATTERY FIRE. ,p>This will commence at 6.0am on 'X' day. Surprise attacks on hostile artillery positions should be carried out with H.E. (with instantaneous fuzes) and gas shells (CG or NC). For the methodical bombardment of fortified emplacements and dugouts, delay action fuzes should be employed.

s. INTENSIVE HARASSING FIRE.

This will commence immediately after the cessation of the special gas (BB) bombardment at 6.0 am on 'X' day. Corps will prepare definite plans for its direction on the respective fronts. The keynote of its application should be variety and surprise, and plans must be so framed that throughout the 24 hours of the day and night the enemy should be permitted no immunity for security from shell fire.

Facilities of observation must be fully exploited in order to limit the area on which unobserved harassing fire will have to be maintained by day. Areas over which no observation is possible must receive special attention.

In allotting tasks for harassing fire, zones in depth must be allotted to different natures of weapons, including infantry weapons and machine guns, according to their range. In this connection the increased range of 18-pdr guns fitted with air recuperators should be taken into account.

Use should be made of gas shells (CG and NC).

Artillery positions should be included in the programme of harassing fire.

In shelling roads, H.E. with delay action fuzes are NOT to be employed.

t. CUTTING LANES IN HOSTILE WIRE DEFENCES.

This will commence at 6.0am on 'X' day, and will be carried out principally with 4.5" hows. and 6" hows. (with instantaneous fuzes) and, where feasible, with 6" Newton mortars. Lanes, once cut, must be kept open by means of rifle and machine gun fire.

u. BOMBARDMENT OF SELECTED STRONG POINTS & LOCALITIES.

This bombardment will commence at 6.0am on 'X' day, and will be continued until Zero with a view not only to the destruction of defences but also to the demoralization of the defenders. Gas shells (CG and NC) should be made use of. It is not considered feasible to carry out a thorough destructive bombardment of concrete dugouts and machine gun emplacements.

The tunnels themselves are impervious to artillery fire. Steps should be taken to concentrate a heavy and unexpected fire on their entrances and exits on the day of battle.

Telephone exchanges and specially defended localities such as BELLENGLISE, NAUROY, BELLICOURT, BONY, LE CATELET, and GOUY, should be heavily bombarded.

Blocks in communication trenches should be created where it is considered practicable and advisable.

v. LONG RANGE GUN FIRE.

Corps will be responsible for dealing, by means of their long range guns, with the following places opposite their respective fronts.

IX CORPS.	**AUST CORPS.**	**III CORPS.**
LESDINS — FRESNOY Rd.	JONCOURT.	FOSSE [?]IGNY Dump.
SEQUEHART.	RAMIECOURT.	
LEVERGIES	MONTBREHAIN.	
	ESTREES.	
	ESTREES-MARETZ Rd.	
	BEAUREVOIR.	

Instantaneous fuzes should be used by all guns firing at long ranges. Railway guns will be retained under Army control, and will engage FRESNOY-le-GRAND, BOIS d'ETAVES, BRANCOURT, BOHAIN PREMONT, MARETZ, BUSIGNY.

w. Resting of detachments.

Careful arrangements are to be made for relief of detachments during the course of the bombardment.

x. HOSTILE GAS BOMBARDMENT.

In the event of a heavy hostile concentration of fire on 'Y'/'Z' night, especially gas shelling, on any particular part of the Army area, every effort will be made, by concentrating the fire of as many guns as possible, to silence the offending groups of hostile artillery.

At the same time, Counter-battery Staff Officers will indicate as accurately as possible to the 5th Brigade R.A.F. direct the positions of the active German artillery. This will be done with the object of enabling the R.A.F. to bomb the groups concerned.

C.B.S.Os. will likewise inform the 5th Balloon Wing, who have arranged to have a balloon standing by ready to take the air within 30 minutes if weather conditions permit. It is hoped that this balloon will be able to give useful information as to the positions of the batteries concerned.

Each Corps will prepare a plan on the above lines. The decision to put the plan into execution rests with Corps.

If the hostile batteries responsible are located in the counter-battery area of another Corps, arrangements for counter action will be made direct between Corps concerned.

y. ISSUE OF INSTRUCTIONS.

Attention is called to the importance of all Artillery Instructions being issued in sufficient time to permit of subordinate formations being afforded ample time to study them and to work them out in detail. No changes in the Artillery programme at a late hour should be permitted without very urgent reasons.

z. DUMPING OF AMMUNITION.

The following amounts of ammunition are authorised to be held in front of railheads.

Not less that 25% of these amounts are to be held in Corps Reserve.

In addition, all echelons are to be kept full.

18-pdr. — 900 rounds per gun.

4.5" How: — 800 -do-

60-pdr Gun — 600 -do-

6" How: — 700 -do-

8" How: — 500 -do-

9.2" How: — 500 -do-

6" Gun — 400 -do-

12" How: — 300 -do-

aa. Corps will issue orders enjoining the necessity for special measures being taken to ensure accuracy of fire.

A list of trigonometrical points fixed by the Field Survey is being circulated down to Brigades of Artillery. This list is intended to facilitate the fixing of positions in the advance.

bb. The pace and timings of the barrage and the nature of ammunition to be used on 'Z' day will be decided by Corps.

cc. In all orders "Rates of Fire" will be described as laid down in G.H.Q., R.A. Circular No. 10.

dd. Each Corps will work out a time table for lifting the fire of long range artillery on 'Z' day from localities in accordance with the rate of advance laid down for our troops.

ee. Special attention will be paid to arrangements for adequate Counter-battery work in the later stages of the battle, especially on the flanks.

ff. Artillery Organization & Allotment Subsequent to 'Z' Day

(see Table "B") [not reproduced]

36: "The Development of Mobile Artillery, 1914-1918," 1919

By Lieut.-Colonel W. H. F. Weber, C.M.G., D.S.O., R.F.A.

Source: *Journal of the Royal United Services Institution* 64:453 (1919): 49-58.

WITH a view to future policy, it may be of interest to examine the development of artillery during the last four years.

To borrow a simile from Robert Louis Stevenson, one should think of "the hand of a clock, which continues to advance as it indicates, rather than the stationary milestone, which is only the measure of what is past. Movement is not arrested."

The information at the writer's disposal is limited—dates given are perhaps inaccurate: nor is he in a position even to hint at the progress of gun construction and manufacture of munitions.

1870-1914.

Prince Kraft's teaching [Prince Kraft von Hohenlohe-Ingolfingen wrote influential works on artillery lessons from the Franco-Prussian War.] contemplated the assembly at the earliest possible moment on the battlefield of the largest possible number of guns under the control of one brain—almost of one voice: this concentration was to knock out the opposing artillery and thenceforth to dominate the battlefield. His theory had to do entirely with tactics in a war of movement.

During the rest of the 19th century professional practice was directed chiefly towards the earlier arrival at effective fire by means of good fire discipline within the battery.

Here we come to the South African War.

The invention of facilities for indirect laying made it possible to bring artillery into action without previously exposing itself. Smokeless powder made it next to impossible to locate artillery thus concealed.

Quick-firing guns, if concealed, forbade opposing batteries to come into action, laying over the sights.

The Artillery Duel as known to Prince Kraft could no longer take place, because the opposing artilleries could not find one another.

Here comes the Russo-Japanese War.

The French improved the firing power of field artillery with their soixante-quinze, and, by adding a shield strove to bluff away the hide-and-seek game and to "rush" success by direct fire from the hill tops. High explosive defeated the shield: back to indirect laying went the guns.

Here came the Balkan Wars of 1912.

It was now evident that aircraft would enable each side to locate the opposing artillery, and that this might re-introduce the artillery duel.

The British Artillery in July, 1914.

A well-known gunner, now occupying an exalted position in the Royal Regiment, described a certain school of artillery thought as having come over "on the crest of a French wave from Calais." According to the group of officers who formed this school, our methods were slow and our policy of training too conservative. They cried for more haste, closer support of the infantry (which was interpreted into actual proximity and a very short range in the final stages of each battle), direct laying, a more rapid rate of fire, less complicated gunnery, less telephone, more tactical teaching at our practice camps. The opposite school, afraid of being hurried into false training, pinned its faith to thorough instruction in gunnery: this school was certainly swimming against the current in 1914. "Field Artillery Training, 1914," chapter VII, was influenced from across the Channel, or at least was considered to be so by the Regiment at large.

The formation of "temporary groups," suggested in section 153, para. 6, was the subject of many discussions; the limitation to such grouping, i.e., "when those efforts cannot be directly combined," was somewhat freely interpreted, if not disregarded, at manœuvres.

It would be unfair to-day, in the light of our experience, to criticise the ideas expressed in "Field Artillery Training, 1914," for that manual was written solely on the basis of open warfare. It seems fair, however, to say that it showed a tendency to discountenance the principle of centralized control so ably set forth by Prince Kraft in his "Letters on Artillery."

The divisional artillery commander had been in existence as such only since early in 1908, and the officers holding the six billets had had little opportunity for practising control in the field. Under peculiar conditions of terrain, Colonel (now Lieut.-General Sir Lawrence) Parsons had given us an excellent demonstration at the relief of Ladysmith of what might be expected from a mass of guns under one man, but, generally speaking, the end of the South African War had brought the Regiment home opposed to the principle of centralized control: thenceforward all thought was directed towards the battle of encounter—where lack of time for preparation would necessitate decentralization.

One cannot shut one's eyes to the fact that previous to this war gunnery was insufficiently studied. The use of the map, in spite of the efforts of a few individuals ahead of their time, was discouraged at practice camps; the compass was seldom used; the effect of climatic conditions on explosives and on the trajectory of the shell was quite unknown to the average regimental officer. A serious effort to teach liaison had been made; Lieut.-Colonel (now Major-General Sir W. T.) Furse had amongst others come into prominence for his inculcation of training in forward observation officer's duties. The influence—the absolute indispensability—of communications, as we see them to-day, was scarcely dreamt of; strenuous efforts on the part of various divisional artilleries to get things on a better basis met with the non possumus from the authorities.

A little elementary co-operation with aircraft had been carried out, and a good deal of discussion and writing had taken place as to the best methods of engaging aircraft with gun-fire. Concealment from the air when in action was rarely, if ever, mentioned within the writer's experience at our practice camps. Drill, turnout, and driving had reached a pitch that we could probably not attain to-day.

The need of re-armament of the field artillery with a new (truly quick-firing) gun was being constantly discussed, and may, for all the writer knows, have been actually initiated.

Lord Nicholson, the Chief of the General Staff, was commonly credited with hostility to the inclusion of heavy artillery in Great Britain's striking force. This may, or may not, be true, but, in any case, there existed the barest nucleus of what exists to-day.

November, 1914.

The first two months of the war taught us to fear observation by hostile aircraft and brought about the beginning of artificial concealment. There was an immediate demand for anti-aircraft guns. The pom-pom arrived in September, the 13-pdr. on a lorry-mounting in December, 1914. We learned, thus early, the need for the F.O.O. with a long telephone wire. No further experience was necessary to convince us that heavy artillery had come to stop as an essential feature of the modern battle.

Winter, 1914-15.—Re-Appearance of Control.

The end of the first battle of Ypres stabilised the battle. The proximity of the opposing infantry lines at once necessitated accuracy of fire, for which we were insufficiently trained; this went beyond the meticulous calculation of angles and touched upon the influence of climatic conditions. It was only want of practice due to lack of ammunition which prevented us from reaching much earlier the high standard of gunnery attained in later days. The flatness of the country forced upon both artilleries an exaggerated form of forward observation and a highly (too highly) organized system of liaison. It became necessary to keep the horses further back, to save casualties to horseflesh; that tended to divide the battery into the gun-line and wagon-line, while introducing the practice of dumping ammunition at the guns. Many of these tendencies re-adjusted themselves during the more open combats of later days, but not before the battle of Cambrai in November and December, 1917. What had come to stop was a new standard as regards the number of guns necessary in relation to number of rifles in the line.

1915. The Development of Centralized Control.

By 1915 we had Army Artillery, as well as Corps Artillery, Commanders, whose powers became gradually but surely developed.

At Neuve Chapelle and Loos artillery movement was abortive, and the field artillery began to adopt siege methods. Fighting maps were introduced. Climatic conditions received continually increasing attention—the first instructions were issued in January, this year. H.E. began to complicate the sorting of ammunition, and the idiosyncrasies of foreign-made shells necessitated much closer attention to the care and management of it.

A new responsibility fell upon the Field Artillery—wire cutting. Other developments:—

a. Trench mortars appeared.
b. New divisions arrived with four-gun batteries.
c. A new word—"camouflage"—sprang into existence.
d. First use of gas (April 22nd).
e. Arrival of "Mother" (9.2-in. howitzer) and "Granny" (15-in. howitzer).
f. Appearance of balloons.
g. Wagon-line changes. Increased use of lorries led to the abolition of brigade ammunition columns, and, later, reduction of divisional ammunition columns. Mules began to replace horses.

The whole tendency against mobility (and consequently in favour of centralization) was encouraged by the issue of carefully prepared defence schemes. The initiation of counter-battery work by the enemy brought into existence elaborate gun-pits: it became so difficult to move guns at night in and out of these pits that the custom sprang up of exchanging guns during a relief; there was much to be said against this. The call for large-calibre shells got even louder.

1916.

Early in the year the amount of heavy artillery had been greatly increased: it was organized in heavy artillery groups with a brigadier-general in command at corps headquarters working under G.O.C.R.A., Corps. The supply of ammunition was at last on a satisfactory basis.

Sound-ranging had started.

Trench mortars had by now been more logically organized: the new 3-in. Stokes remained with the infantry; the 2-in. and (about June) the 9.45-in. [mortars] became attached to the divisional artillery under a Divisional Trench Mortar Officer,* who, though perhaps not himself a gunner, generally formed part of the divisional artillery staff. Opinion varied as to whether trench mortars should be run by the general staff of the division or by the C.R.A. The one party argued that they were employed with, amongst, and against, infantry, and that it was always infantry who had to carry up their ammunition: therefore they should be run as a divisional (not

divisional artillery) concern. The other party said that trench mortars provided an integral portion of the preliminary bombardment, and that they used the ordinary artillery methods of fire, therefore they should be part of the divisional artillery. Gradually this latter idea obtained the upper hand, chiefly because it was only when run by the artillery that they received proper consideration and supervision, but in everyday work, this system took the Field Artillery Brigade Commander out of his daily sphere of work.
[*First Divisional Trench Mortar Officer was appointed in March, 1915.]

Immediately before the battle of the Somme was witnessed a really big concentration of artillery: that behind Maricourt, where (owing to the shape of the line) the British and French artilleries were mixed up, was a most remarkable sight. The danger angle of our practice camp days was no longer considered.

The necessity of buried communications was now thoroughly appreciated, preparations being made accordingly.

The first meteor telegrams were issued in April, 1916.

It should be mentioned that, early in the year, divisional schools had been established: divisional artillery schools were added, but were soon abandoned in favour of army artillery schools, amongst which that organized by Lieut.-General Sir. A. E. A. Holland (G.O.C.R.A., Third Army) obtained notoriety.

It is here that we come to the battle of the Somme.

Early in the battle we had our first experience of gas shells on a big scale, used by the enemy principally to interfere with our assembly.

The biggest development of the Somme was, however, the creeping barrage as we know it to-day. The idea was far from new: it had been attempted in South Africa, and was commonly practised by the French whenever they had the observation to do so. The enemy, finding he was losing all his machine-guns by our bombardment if he put them in his trenches, took to placing them in the open between trenches, so that our fire, lifting from trench to trench, missed them. To obviate this, the Field Artillery fire (XVth Corps, General Sir H. S. Horne) was directed so as to move forward just in front of the infantry with the purpose of annihilating every living thing opposing them. The new thing in this was that it was done by the map, the lifts being timed to suit the pace of the infantry advance, according as to whether the country was open or close, and the terrain rough or smooth. What was not foreseen was the high degree to which the idea developed. Limited at first to 18-pounders, it was later given depth by the addition of 4.5-in. howitzers, 6-in. howitzers, and even 9.2-in. howitzers. Not only was it used to protect the infantry during the advance, but actually to control their movement and the direction of that advance; for, if you must follow a thing, and it moves, you are no longer your own master. Eventually it became the main feature of the attack, so that the infantry could sometimes walk behind it with slung rifles, the only proviso being that they must be as close to it as possible, so that insufficient time should elapse after the barrage had passed an enemy hiding place to allow him to emerge and open rifle or machine-gun fire. The development of the creeping barrage, under favourable circumstances, and well practised by both field artillery and infantry, accounted for the capture of large numbers of prisoners in 1916 and 1917, and did much to knock out the famous "dug-out" system of defence—but the difficulties of preparation added a number of grey hairs to the British Artillery before it became a "drill." Very much more might be said on the subject: it is not, however, proposed to go into further detail here.

In some of the Somme episodes the ground gained was sufficient to entail movement on the part of the artillery. The difficulties of maintaining forward observation on the move were felt at once. Pigeons began to be used from observation posts, and, even as early as this, wireless.

Portable camouflage nets became battery equipment after the Somme.

In the later stages the mud was so appalling that all ammunition had to be carried up on pack-saddles. No one who did not get personal experience can appreciate what drivers went through bringing up ammunition to the guns under such circumstances.

An important result of the experience gained on the Somme was the formation of Army Field Artillery brigades. Up to then, the divisional artillery had consisted of first four (three 18-pounder and one 4.5-in. howitzers) and then three (mixed) brigades. Batteries were nearly all four-gun batteries. It was found that, in order not to interfere with the artillery bombardment arrangements, a divisional artillery had to be left where it was in the line regardless of its infantry. In the later stages of the battle it was rare for a divisional artillery to cover its own infantry. The infantry went in and came out: the gunners went in but came not out for many a week. To ensure the divisions being still formations of all arms, in which infantry and artillery were accustomed to co-operate, one artillery brigade was taken away from each divisional artillery and made an army field artillery brigade: it was hoped in this way to ensure that a division could move complete in and out of the battle, while the higher artillery authorities obtained a reserve of field artillery at their immediate disposal. In combination with this change of organization batteries were increased to six guns each, largely in order to economize officers.

Stated generally, public opinion after the Somme was something as follows:—

h. It was recognized by the fighting soldiers at large that, instead of the artillery being called in to support the infantry where the latter wanted to attack, the infantry could attack whenever it was possible to employ a sufficient amount of artillery.
i. The preliminary bombardment warned the enemy of attack: therefore, that the true artillery battle must begin simultaneously with the infantry attack, i.e., at zero.
j. Too much bombardment made such terrible havoc of the countryside that infantry could not recognize their objectives when they got them.
k. Batteries became less parochial-minded in their choice of position; to quote Bairnsfather: "an 'ole" was necessary—if it was a "better 'ole," so much the better for the battery.
l. Heavy artillery became recognized as the offensive branch of the regiment: counter-battery work became its principal duty; the field artillery in a war of position performed protective duties only.

m. The field artillery, at any rate, could hope for little rest, in that it required the divisional artillery of two, three, or four divisions to cover the infantry one.
n. The Tank had made its debut, with all its immense possibilities for future traction of guns.

1917—To Passchendaele.

Centralization continued to develop as a result of position warfare all through 1917 on the lines already indicated, until individuality was well nigh starved out of existence.

We got the recuperator for the 18-pounder,* and the 6-in. Stokes trench mortar with its increased range.
[*The first recuperator arrived as early as May, 1916.]

The use of smoke by artillery was much developed.

Ammunition sorting was now becoming a great burden to the battery commander.

The indispensability of good communications to allow of so much centralization was marked by the transfer of R.A. signallers to the R.E., and the addition of a Signal Officer to each field artillery brigade staff.

In the heavy artillery a special Counter-Battery Staff Officer came into existence (July 1st, 1917), and sound-ranging was extensively developed: quite late in the year the R.G.A. was formed into permanent brigades instead of in constantly-changing heavy artillery groups. Heavy guns were included more and more in the creeping barrage, but there was no outward and visible sign yet that the Artillery was to be treated as one arm: the R.G.A. and R.F.A. were still kept well asunder.

We began to be considerably annoyed by enemy bombing, not only horse lines at night but even our gun positions.

The artillery suffered a great deal in the later stages of the battle of Arras from enemy counter-battery work. The terrible struggle for the Passchendaele Ridge followed; with such a mass of artillery for the enemy to fire at, with the impossibility of digging, with the harassing of the Flanders roads at night, and the new mustard gas, it is a matter for wonder that we carried on as we did—and, remember, we were already quite outranged by the German artillery. We came out a different regiment—interpret the phrase as you will.

1917.—Battle of Cambrai.

The Third Army attack in November, 1917, was remarkable for two things. In the first phase it was deemed necessary to procure surprise: the Germans had shown us how to do it at the Caporetto. The whole of the attacking artillery opened fire on the morning of November 20th without having fired a single registration round. Every gun had been calibrated in a back area (though not yet by the screen method), every position had been resected: positions were occupied only at the last possible moment. The surprise was complete.

In the second phase the Third Army was surprised by the German counter-attack on Gouzeaucourt on November 30th. In a few moments the whole elaborate system of control fell to pieces like a house of cards.

Unfortunately, only a small proportion of the Regiment participated in this valuable experience.

1918.—Decentralization.

The three German offensives in which the British artillery was engaged, followed by the great Entente counter, completed the teaching initiated at Cambrai. Decentralization occurred everywhere, though it hardly had time to affect the methods of employing heavy artillery; but even in this matter progress was seen, for a brigade of R.G.A. was affiliated early in the year to each divisional artillery. Control became limited to what the controlling authorities could arrange before the battle—allotment of guns to each front, and the barrage for each battle. The individuality of subordinate officers came again into play, more especially in the case of the field artillery brigade commander, to whose lot, if senior, fell the command of anything up to five brigades.

Our chief lessons from the German offensive were in the handling of guns in a big retreat. The preparations for it, as applied to the artillery, were tested to the ultimate degree—most of all the theory of "depth" and "silent batteries." The mounted or dismounted orderly soon replaced the telephone wire; patrolling reappeared; the wagon-line became once more an integral part of the battery in action; the exaggerated form of liaison we were doing with each infantry battalion disappeared like the forward observation officer in the front line with two of three miles of wire behind him.

Heavy artillery battery commanders, when in difficulty, placed themselves at once under senior gunners on the spot.

When we, in our turn, attacked, the Regiment had regained its liberty. Barrages could never be dispensed with, but it was found possible to organize them on much simpler lines at the shortest possible notice: they were essentially "protective" in character. Rapid reconnaissance of positions was followed by rapid shooting-in: fighting by eye to a large extent replaced fighting by the map. To secure surprise, the preliminary bombardment of other days (and sometimes all registration) was dispensed with. The trench mortar died a welcome death; no wire was laid until it was seen to be necessary; even dumping was becoming a thing of the past. The armistice came before the process had reached a logical conclusion—which is a matter of regret, if one considers it from a point of view of training in the future.

The Future.

Policy for the future is doubtless sub-judice. The writer only ventures to summarize certain features of our experience.

15. Technical Training.—Position warfare took up three years and four months out of four years and three months. We cannot afford to disregard the fact. Much of the annual practice must be devoted to purely gunnery problems, involving consideration of climatic conditions, and leaving movement out of consideration: it is only by ammunition that we can hope to learn. A new "Field Artillery Training" might contain a set of standing orders for a gun-pit as a guide to future battery commanders. Young officers should be specially trained in the duties of a forward observation officer—particularly as regards the signal service: they should be expert linesmen and have a working knowledge of all telephone instruments they are likely to deal with. They should be far more expert masters of all forms of equipment. The trench mortar service should not be left out of consideration.
16. Tactical Training.—It may be taken for granted that co-operation with aircraft and the engagement of aeroplanes will be commonly practised.
17. The work of artillery at manoeuvres needs a very much higher degree of examination by expert umpires than has been the case in the past. Whether the battery can clear the crest, has had time and has tried to shoot itself in, whether communications are working, and whether the battery is well hidden, whether it showed itself before it opened fire, are points on which its efficiency vitally depends.

    Manoeuvres are troublesome things, because they are three parts dependent on imagination: the special tactical training a battery commander can get at manoeuvres has been terribly neglected in the past in favour of the professional reputation he can snatch for himself and his battery at practice.

18. Organization.—The degree of control seems to depend on the amount of time available before battle is joined. Because, in times of position warfare so much could be done by the G.O.C.R.A., Corps, and because the divisional artillery was for certain definite reasons reduced—some people considered that the Divisional Artillery Commander (C.R.A.) had been "squeezed out." This does not appear to be the case, as became evident during the 1918 fighting. The Divisional Artillery could well be increased. It needs a C.R.A. more than ever, and must be trained with its infantry to ensure training in co-operation.
19. That part of the heavy artillery which is reasonably mobile ought to be part of the divisional artillery. It is beyond doubt that efficiency has been sacrificed through the existence of two regiments of artillery: it is not too much to say that the schism has at times been a laughing-stock to the infantry. It is one of the points which can easily, and ought to be, improved. Why not a Field Artillery "Group" consisting of the present field artillery brigade, one battery of 6-inch howitzers or 60-prs., one trench mortar battery (formed on mobilization), and one group ammunition column? The heavy howitzers cold be separately organized, and the purely coast defence guns be taken over by the Admiralty?

20. Co-operation.—Perhaps the most pressing need of all is to continue to bring infantry officers into close touch with artillery methods. The whole management of artillery is an affair of communication. Many an artillery commander, in his fever to keep close alongside the infantry, has jeopardized his ability to control fire, only to find that at the last moment the infantry commander has changed his headquarters and rendered the artillery communication inoperative.

    "Liaison" is a catch-phrase for the unwary: the very best liaison officer is not to be compared, for efficient co-operation, with the artillery commander himself.

    Numerous pamphlets have been issued saying the two commanders must be together, and that the infantry commander must consider artillery needs. In practice the question of what accommodation there is, and how comfortable, carries infinitely more weight. In the writer's humble opinion, "G" might take up this important question with more weight.

21. Equipment.—A battery needs at least five officers, even if a four-gun battery—but we have been well treated as regards numbers of officers. It needs a complement of all trades. Most gunners whom the writer has met appear to like the four-gun organization best. It is greatly to be hoped that in the next war we shall have less complicated ammunition—and that we shall not be out-ranged.

    Would it not be possible to save an immense amount of work by issuing harness with oxidized (or some other form of) metal work which could be washed clean?

    Should Tank Traction be considered?

22. Communications.—The signal service is not yet sufficiently developed. It is the whole basis of control. If the R.E. is so much preferable to the R.A. signaller, it would be logical to extend the system to batteries.

    The artillery brigade or group needs a despatch rider service and arrangements for "wireless."

23. Personnel.—It is beyond hope that we can ever get a finer lot of officers and men than joined the Regiment when war broke out. It may be doubted if the whole annals of artillery contain anything better than the fortitude and endurance shown during Passchendaele, or than the gallantry displayed during the German offensive in 1918.

(*Written on the march to the Rhine, December, 1918. — W.F.W.*)

37: Anon., "Artillery and the General Staff," 1919

Source: *Journal of the Royal United Services Institute* 64:455 (August 1919): 470-77.
By F. W.

Assumptions.

LET it be granted —

i. That, subject to ordinary human desire to be safe and comfortable, and to get the usual ration of sleep, the great ideal of "gunners" is to support their infantry properly, which corresponds to all other great professional ideals; for instance, the success of a raid was a very real pleasure to the gun detachments.
ii. That a battery starts the war fairly efficient, but short of experience, and that, as it gains experience, it loses efficiency from casualties.
iii. That the rank and file of any unit knows little about things outside its own sphere of life.

Foreword.

The writer spent half the war as a General Staff Officer and half as a Regimental Artillery Officer—his only excuse for the following platitudes.

Often there is no artilleryman on the staff of a formation of all arms; the influence of the formation staff, shy of artillery technique, is exercised largely in saying "Don't," like an anxious nurse, and not always giving the maximum assistance to the Artillery Staff Captain, part of whose work is the comfort of the artillery, but whose position is too junior to get all that is necessary, and whose hands are already full of priority work dealing with ammunition.

It is not pretended that the artillery is blameless. Gunners prefer to run their own administration (and, indeed, it is the best solution of the problem), but once taught by experience to look for help from their Formation Staff, they will not try to obtain the necessary assistance through some other channel—a course which may work against true co-operation. The writer once heard on his telephone a conversation between an outgoing and an incoming (artillery) brigade-major; said the latter: "I suppose I must tell 'G' we're in?" "Why?" said the outgoing man, "they never think of us." That speaker is now a senior General Staff Officer, and one wondersŠ. A wrong spirit, of course, but not so uncommon as it should be, and provocation for it is not always absent. One plays into one's partner's hands unless one has overwhelming cards oneself. The infantry and artillery are, or should be, partners in the greater game.

"G" and the Artillery.

It is suggested that the assurance of co-operation between infantry and artillery is the special duty of the senior G.S.O. (The word co-operation implies that the assistance must be mutual.) To perform the duty doubtless requires "personality," but that kind of personality can be gained by study, because authority is based on knowledge. The duty has two phases—initiation and observation, both of which demand a degree of expert knowledge of artillery matters; G.S. must put Training on the correct lines, but that does not absolve it from the duty of Criticism during progress.

Granted the initiation has been correct, responsibility for criticism can be allocated: for instance, G.S. is probably the best critic of opportunity for fire, while the Technical Staff is the best judge of effect; whether delivered from the right place interests both critics. Again, in battle, the Artillery Commander is the authority to criticize the positions occupied (subject to certain limitations), the upkeep of equipment, and the soundness of the gunnery; but a good General Staff Officer can efficiently test and criticize communications, observation, alarm arrangements, liaison, distribution of batteries, and their mobility; and G.S. are scarcely ensuring co-operation if not personally acquainted with existing conditions in this respect. The knowledge gained by the critic in his attempt to criticize will be the very life-blood of orders that he may be called upon to give in the future, for a mental picture of conditions as they are will be present to him when fighting by the map.

One cannot rest satisfied after grouping a body of infantry and artillery together unless (a) one is acquainted with the two commanders; (b) those two commanders have worked satisfactorily together before.

It is not asking too much of G.S. occasionally to watch bombardments; it requires no great technical knowledge to see whether the right target is being bombarded, whether the shrapnel is bursting evenly, while a hint that the Commander is watching shooting with his own or his representative's eye must have a salutary effect at the gun-position and the O.P.

Synchronization is a G.S. duty, and amongst the writer's unpleasant experiences has been one in which casualties were caused to the infantry owing (ultimately) to the fact that the responsibility for synchronization had not been definitely allotted to one individual.

Occasionally—in fact too often, under our system—a force of artillery is brought into action which is not under direct command of the senior artillery officer of the formation responsible for the operation; it then becomes the duty of G.S. to ensure that things are put on a correct basis. To exemplify this, one can quote the sad case of a G.S.O. who could not at a moment's notice answer the question as to exactly what heavy guns were actually cutting certain wire on his division's front; it was, as a matter of fact, impossible to say, for the heavy guns in question were not under the divisional C.R.A., and had not one but several tasks—i.e., the arrangements were not on a satisfactory basis; had their G.S. made it their job to ensure they were, not only a reputation but a number of soldiers' lives might perhaps have been saved.

Gunners want rest and sleep, relief and training, like everyone else; this is for consideration by the General as well as by the Technical Staff—one usually finds G.S. pretty careful as regards its infantry.

It is the greatest compliment the "gunners" can receive to know that their own infantry are glad to have them close at hand, but a divisional artillery has been known to crawl back half destroyed from the battle into its own division's rest-area, after an extra long turn in support of other troops, without any marked exuberance of feeling about its arrival; it is as if one failed to notice the return of one's mate after an absence. It is possible that the gunners are equally to blame.

Training.

The principal method of initiating co-operation is by ensuring that each arm gets practical experience of its partner. This has been attempted in several ways: —

d. By attachment of selected officers and selected N.C.O.s for periods not under one month; two months would be better. We ought to teach N.C.O.s to deal with units other than their own. The attachment should be at a period in the year when men's minds are occupied in other things than football and leave, but it need not necessarily be during manœuvres. It is essential that the attachés live with the unit to which they are attached. The personality of the individuals attached is of the first importance—to send (in topical slang) "duds" does more harm than good; those selected should be "professional soldiers," capable of strong views and of upholding those views in discussion. On less important exercises, the attachés should perform the duties of their rank. At the end of the attachment the attaché should send in to his own C.O. a report of his attachment under specified headings, and the writer sees no reason whatever to exclude criticism from those reports—it is only by criticism that one learns to differentiate between bad and good, and, besides, it tickles the palate.

e. By attendance of artillery officers at tactical musketry and of infantry officers at tactical practice. The schemes for such exercises might be made in consultation with a representative of the partner-arm; but, where competition comes in, it is doubtful if it is wise actually to employ the attachés during the exercise.

f. By lectures—lectures to infantry by an artillery officer, or a G.S.O. presenting the artillery side of the question; lectures to artillery by an infantry officer or a G.S.O. presenting the infantry view. The presence of G.S. at such a lecture is much appreciated by the artillery, and representatives of each arm should be detailed to discuss the question at the end of the lecture; a little "sparring" does no harm, and, if tactfully conducted, loses nothing from the sharpness of the thrusts delivered, while it will almost certainly occasion domestic discussion that evening.

g. Through tactical schemes (field days). It is impossible to make a scheme for artillery without considering where the infantry would be; but the writer has been present at many infantry schemes in which the artillery has been entirely left out; even if it is only to say "there is no artillery present," it is something. A tactical scheme ends in a conference or discussion; the representative of the partner-arm should as a matter of drill be asked what he has to say on the exercise.
h. By simple tactical exercises (without troops) conducted by G.S., in which a situation is given, and the infantry and artillery positions selected on the ground and visited in detail, reasons being given by the officer who selected them for their selection—defilade, camouflage, background, supply of ammunition, facilities for exit, etc.

It might be beneficial if the same terms and habits were in force in each arm—in such simple things as the mode of measure of lateral angles, the use of the degree and minute, and so on. Both arms need instruction and experience in map-reading and resection of position—more mistakes have occurred from incorrect resection than one cares to contemplate; mixed classes from infantry and artillery could study this subject together, also the practice of reconnaissance and patrolling.

So much for the G.S. duties in initiating the principles of co-operation; it remains to ensure that these principles are being carried out in practice.

Criticism of artillery work at manoeuvres has not in the past been efficient; so noticeable was the lack of attention to the part taken by artillery, that it became an expensive but effective custom, just before the war, for the artillery to draw attention to itself by firing off rounds of blank at a quick rate of battery fire (or salvos) to remind all and sundry of its existence; the umpiring needs to be done every bit as carefully at manoeuvres as at "practice." A battery which has exposed itself previous to occupation of a position, guns emplaced where they could not clear the crest, breakdown of communications, are causes of inefficiency, which, if passed unnoticed, constitute bad training and will at the great test occasion failure and casualties.

Co-operation between heavy and field artillery needs as much "forcible feeding" as does that between infantry and artillery.

Position Warfare.

Normally, position warfare implies the local defensive, and the obvious thing to work for is a good S.O.S.—i.e., alarm arrangements. The exploitation of light signals in our army took place only very slowly. Failing the use of coloured lights, one is dependent on communications, a just appreciation of the importance of which is the first step towards the proper direction of artillery fire. The writer was on a certain occasion ordered by the Technical Staff to construct rearward positions in the event of a withdrawal; now reconnaissance of rearward positions is a necessity, but construction is of doubtful value, for they get known to the enemy, and, worse still, they tempt batteries to occupy them even if not suitable to the tactical situation of the moment—and so it turned out on this occasion. The labour devoted to building rearward positions would have been better expended on burying communications in the forward area, for it is conceivable that a good artillery defence might have obviated the need to withdraw at all; it was thought that G.S. might have laid down such priority in the defence scheme.

When compiling the defence scheme, there is a very human tendency on the part of the collator to get it completed and to accept contributions for the purpose without properly examining them. A defence scheme existed in which the artillery defence formed one (not even the first) of many appendices. The point is that the artillery and the infantry defence are inseparable and interdependent. G.S. initiates proper co-operation by a defence scheme; a further task is to see that it is properly studied and applied by each single unit, artillery as well as infantry, to its own circumstances.

Artillery defensive arrangements do not, however, consist only in the putting up of a good S.O.S. barrage; they must contemplate artillery action (a) before the attack, in the shape of counter-preparation, (b) after the assault has taken place; first attacked on March 21st, 1918, the writer does not remember being informed of a definite policy regarding (b) until July, when it was laid down that in event of a hostile offensive, batteries would continue to fire on their old S.O.S. lines unless otherwise ordered, so as to stop hostile reinforcements—a very, very old policy half-forgotten; certain artillery units were detailed, whose fire could be switched on to any gap which the enemy may have forced. It is not the object of this paper to discuss whether such a policy was right or not, but rather to note the need of a G.S. policy of some kind.

In position warfare, there is generally very little trouble as regards liaison and observation, but the certainty of being able to speak to anyone at short notice in an old established line led to the emplacement of O.P.s in positions quite unsuited to an enemy offensive and to an exaggerated expectation of liaison on the part of the infantry, which it needed such a shock as the German offensives in 1918 to rectify. For observation and a good artillery defence, the one essential is safe communications—far more so than in the attack, at any rate until the artillery has moved forward and is once more on the defence against a counter-attack.

The early stages of an attack from and against trenches are better understood; or may it be that they are made before that bugbear, the will of the enemy, has been consulted? In any case we seemed efficient at the art of distributing responsibility for bombardment (when once the creeping barrage had become a drill), of fixing the first line of the barrage, the lifts, and the protective line, so far as position warfare was concerned. In the later stages of an attack, however, especially where a salient had been formed, there cropped up often the question of short shells—the great enemy of good feeling, and one which demands intimate knowledge and patient study on the part of G.S., before one approaches the truth. It is perhaps worth while to enumerate the various kinds of evidence which help to settle this question: —

- i. A dud shell or a bit of a shell, picked up at the time;
- j. the exact place the shell fell;
- k. the exact time it fell;
- l. the direction, of possible, by flash; failing that, by sound;
- m. whether the offending projectile was light or heavy, came fast or slow.

One can then hope to find out what guns of what calibre were firing at that time, and test the suspected gun. The writer, having good and clear evidence from the infantry, was on one occasion able within thirty minutes, by the process of elimination, to fix responsibility on one of two detached sections out of a group of seven batteries; and an honest officer, who perhaps deserved praise for his honesty as well as censure for the mistake, pleaded guilty to a wrongly-set sight; another time a bad-shooting gun was located; more often no decision was reached, and one had to suspect the enemy of the offence. No amount of trouble on the part of the Staff is too great to get a definite answer to this gravest of complaints.

One cannot leave this chapter without reference to trench mortars. In position warfare they provide a lion's share of the preliminary bombardment, from which it is argued that they should be under the artillery, though the supervision of their work takes the artillery commander out of his usual sphere—which has its advantages as well as its defects. On the one hand, it can be argued that they are sited in the infantry area; that they fight in support of the infantry, against the enemy infantry area, and that infantry are almost always required to carry up the ammunition; and that therefore they should be controlled by G.S. working through infantry channels. This was a controversial question at one time, but decision generally favoured making them an integral part of the artillery.

In position warfare, especially, G.S. has to ensure working co-operation between the artillery and aircraft.

War of Movement.

We never reached this war of movement, unfortunately; we got near it at times—forming up for assaults on ground practically unknown, almost unlimited objectives, disappearance of telephonic communication in the later stages, disappearance of ammunition dumps at the gun positions, etc. Barrages we were never able to dispense with; in fact they were so much in demand that it almost needed interference from G.S. to limit that demand. It was in connection with these "lightning" barrages that the artillery was hardest tried; for they are never easy to arrange if they are really needed, and the delay caused by continual changes in "forming-up places" and "first objectives" used to result in insufficient time at the gun-positions to put them properly into execution—a thing which, owing to the really strenuous efforts of the artillery, G.S. perhaps hardly realized.

In such actions as one was called upon to fight from August, 1918, till the armistice, development could never be foreseen; communication by mounted orderly only was not feasible in the preliminary stages of such a battle, and telephonic communication was essential for such matters as dictating the moment for guns to advance. As before, so still at that period, the proper direction of artillery was dependent on telephonic communication; once the headquarters had been fixed upon, and wires laid out, dispositions could not be changed under several hours' notice. The aim of the artillery was to have its headquarters with those of the infantry it was supporting, the better to be able to deal with what circumstances might arise; if, after laying out the artillery plan in wire on the field, the infantry headquarters were changed, the infantry and artillery commanders became separated, and the artillery had to be represented at infantry headquarters by a liaison officer. But no liaison officer is as equal to the task as the artillery commander himself; unless he has the rank and personality and knowledge to gain the confidence of both his own commander and the infantry brigadier, he is almost useless—and such officers were almost always commanding their batteries.

Without going further into this subject, it may be admitted that "liaison" between infantry and artillery is what G.S. must principally watch when the battle begins to move; and there was a widespread feeling in the artillery that (granted the importance of the two commanders being side by side) infantry brigadiers did not always sufficiently consider the necessity for the artillery commander being located where it was possible for him to direct his fire (i.e., control his batteries) as well as to keep close touch with the infantry progress.

Facilities for observation also want watching; not so much the choice of an O.P., which may be left to the artillery, but the gaining of ground by the infantry which is needed for artillery observation.

The writer's experience is that G.S. could get better value for information during the battle from the mounted patrols which the artillery must for security send out to the flanks; or perhaps it is that the artillery commander did not always report back the very valuable information that these patrols sometimes obtained, when well handled.

G.S. fixes zero, but occasions have been known when the artillery, hard put to it for issue of barrage orders and supply of ammunition, might have been consulted.

In the more "sticky" stages of an advance, when the enemy is only being beaten back very slowly and is well provided with guns, the artillery needs a helping hand as regards allotment of available accommodation; everyone knows what happens to dug-outs in a just captured area.

Suggestions.

It requires some temerity on the part of the writer to make the following suggestions for the better performance of G.S. duties towards artillery:—

(a) It is easier to discuss matters when people live together in the same house; artillery needs are reported to the artillery commander if they cannot be adjusted on the spot; the artillery commander (whether brigade, division, or corps is concerned) is, from the artillery point of view, best situated in mess with the infantry commander, if it be possible to overcome parochial difficulties to attain the great end.

(b) However good the artillery, however capable its commander, support will be better for sustained observation and reasoned criticism by G.S. For this criticism some degree of technical knowledge is desirable. Moreover, liaison between heavy and field artillery is sometimes lacking, which G.S. can discover, even if they cannot rectify.

(c) An operation order should never be written without some reference to the artillery—even if it is only to say (for the benefit of an incoming formation) that "such and such artillery (Commander So-and-So) is in support of the outgoing formation"—or that "the 100th Division (less artillery) will be relieved on the night X/Y." Orders and Instructions are seen too often whose wording shows that the writer was thinking only of infantry.

(d) There should be an officer on every artillery formation staff to deal with ammunition—he works partly with "G" and partly with "Q"; his existence will allow of the better performance of the real "Q" duties by the present overburdened staff captain

38: "Artillery Development in the Great War," October 1920

By Lieut.-General Sir Noel Birch, K.C.M.G., C.B., Colonel Commandant, Royal Artillery
Source: *The Army Quarterly* 1:1 (October 1920): 79-89.

"Four years of scientific warfare have seen a consistent and progressive development in the power and influence of artillery, both in the actual fighting battle and in all the stages which lead up to it. Despite the handicap under which we started the war, British artillery has played a large part in that development, and of late has dominated the enemy's artillery to an ever-increasing degree. The influence of the fact upon the moral both of our own and the enemy's troops could scarcely be imagined."

Extract from the Dispatch from the Field-Marshal, Commanding-in-Chief, British Armies in France, dated the 21st of December, 1918

Volumes might be written on the subject of this article, but the time is not yet ripe. We are too near the events of the Great War to see them as our descendents will see them, without prejudices and with fuller knowledge of the facts as a whole.

I shall not refer to demands for artillery material previous to 1916, but propose to give, first, the reasons which prompted Field-Marshal Lord Haig to ask for so many guns, and some idea of the work he required them to carry out; secondly, to describe the organization and the staff machinery set up to handle the enormous mass of artillery which came into being over and above the amount allotted to divisions; and thirdly, to state briefly the innovations introduced and the scientific progress made by the British artillery during the war.

I. The Necessary Artillery And Its Role.

Guns and ammunition cannot be made in a day. Before construction can begin, jigs* and gauges have to be manufactured and machinery either made or adapted for the purpose, and this takes a long time. Other points concerning manufacture which are not always appreciated by the layman are that the adoption of any technical improvement, either in the construction of the gun or of the ammunition, immediately reduces total output for a considerable period, and that when a new gun or howitzer has been made, it has to go through extended firing tests, and, in most cases, travelling trials, before it is fit to take the field. The history of this war proves, as former wars have often proved, that improvised artillery material is the reverse of satisfactory.
[* A jig is an appliance to hold the work and guide the tool, or tools, in repetition work, so as to ensure that all parts machined on the same jig are interchangeable.]

The British Artillery owes a great deal to Major-General Sir Stanley von Donop. It was due to his foresight and initiative that the 9.2" Mark I. Howitzer was introduced, probably the best and most reliable weapon the British put into the field, and the only modern heavy howitzer available at the outbreak of war. It was in 1908 that he first began advocating the use of the heavy howitzer in the field, and in July, 1914, the first 9.2" Mark I. Howitzer, designed and constructed under von Donop's guidance, passed its test. This weapon gave comparatively little trouble in the shops, which cannot be said of some of its more hastily designed brothers.

In 1916, when the Field-Marshal submitted a fresh programme of construction, orders for artillery material which had been given in July, 1915, were nearly completed. As at that date the early delivery of more guns and ammunition was a matter of vital importance, in view of the fact that the British line was being lengthened and new troops were arriving in France, he selected the latest "Marks" of existing models, adopting this policy in order to facilitate construction and to ensure uniformity in design. The elimination of a variety of existing natures of guns was not therefore immediately practicable.

In submitting his programme, however, the Field-Marshal insisted that every endeavour should be made as time went on to increase the range and accuracy of our guns, and that there should be no cessation of research and no finality of design. But in 1916 quality had to give way to quantity. The two main principles on which the construction programme was based were as follows:

1. Having ascertained from the best information available the number of guns per division in the German Army and the increase the enemy was aiming at, to ask for such a number as would give the British a decisive fighting superiority.
2. Heavy guns only to be used for work that heavy howitzers could not do.

The preference for the howitzer over the gun caused a certain amount of criticism at the time, some of it uninstructed and some hardly to be called disinterested, but the reasons for laying down the second principle were both clear and sound.

The "life" of a howitzer—that is to say the number of rounds that can be fired from it before it becomes unserviceable from wear—is far longer than that of a gun. For example:

The 6" Gun, Mark VII., has an average life of 1,500 rounds.

The 6" Howitzer, 26 cwt. has an average life of 10,000 rounds.

The 9.2" Gun, Mark X. has an average life of 500 rounds.

The 9.2" Howitzer, Mark I. has an average life of 7,000 rounds.

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As every weapon had to go back to England to be relined and generally renovated, it is obvious that the second principle was not only sound, but necessary from a manufacturing point of view. This, however, was by no means the only reason. The howitzer is comparatively easier to position in the field. Many can be sited in a comparatively limited area owing to the high line of departure of the shell, and the problem of crest clearance is rarely met with. Howitzers have less range than guns of a similar shell power, but are more mobile, and, when fired at horizontal targets their accuracy is generally speaking better.

The continuous artillery battle which began on the Somme and culminated as it did in the defeat of the enemy's guns (vide Field-Marshal Lord Haig's Dispatch of the 10th of April, 1919) would have been impossible if the proportion of medium and heavy howitzers to heavy guns had not been large. His demand worked out to be 70 per cent. howitzers and 30 per cent. guns, but these proportions were never quite reached, owing to the delay in the delivery of the heavy guns. This delay was no fault of the Ministry of Munitions, as gun plant had to be diverted after orders had been placed for the manufacture of anti-submarine guns for merchantmen.

There were 486 guns and howitzers in the original Expeditionary Force, 24 of which were of medium calibre, and on the day of the Armistice there were no less than 6437 guns and howitzers of all natures in France (exclusive of anti-aircraft artillery and mortars), of which 2211 were medium and heavy artillery. This number was below Lord Haig's original demand, but it must be remembered that the Ministry of Munitions was obliged to supply other theatres and other nations with artillery material; and further, that in the last year of the war more men were not available to man more guns.

The work which Lord Haig required his artillery to perform was, briefly, to destroy the enemy and to protect his own armies. Various kinds of fire were made use of in attempting to attain this high ideal. To dominate the enemy's artillery continuous counter-battery work was employed. The "barrage" covered our infantry in the attack. Harassing fire by day and night did much to make the enemy's roads and paths difficult to use, and often delayed and even stopped the bringing up of his rations. How science and experience helped to develop these and other methods of fire will be told later.

II. Organization And Staff Machinery.

It will be plain to any student of war tactics that, other things being equal, the commander who can rapidly concentrate masses of artillery when and where he chooses has a great advantage over the adversary who is unable to do so. Napoleon taught Europe that artillery should be employed in masses in order to prepare for decisive action. The victories of Friedland, Austerlitz and Wagram can be largely ascribed to his having observed this cardinal principle, which means concentration at the right time and at the decisive point.

To make quick concentration possible artillery organization must be elastic. This primary condition can only be fulfilled if the minimum number of guns required form an integral part of the unit organization.

It will be convenient to discuss the organization of the field artillery and of the heavy artillery in France separately.

It is clear that if all the field artillery belongs organically to divisions, reinforcement cannot be effected unless all or some of the guns are taken from one division to support another: the divisional organization is then dislocated and may remain so for a considerable time. In offence or active defence the infantry of a division tires and must be relieved earlier than the artillery. Therefore, during active operations on a large scale and under conditions such as obtained in France, the guns soon become separated from the rest of the division, and to bring them together again is a tedious process. Divisional artilleries are continually on the move to rejoin their formations and, in doing so, much gun-power and tractive energy are wasted. Serious administrative troubles also arise.

Our available resources in 1916 would not admit of the creation of a considerable number of fresh artillery brigades, and it thus became necessary to reduce the divisional artillery from three brigades to two, and to form a fluid reserve by organizing independent Army Field Artillery Brigades. This introduction was a success from a tactical point of view, and, although it did not entirely do away with the difficulties referred to above, there was much less separation. Moreover, reinforcement was easier and more economical.

It was originally intended that these army brigades should be grouped together, either two or three brigades forming a group. It was felt that they would be better cared for if they had a colonel and staff to attend to their immediate wants, and to represent their case when work was too prolonged or too severe. Neither officers nor men could, however, be spared to form these group headquarters, so the project had to be dropped.

Generally speaking, the army brigade was nearer to the enemy than the heavy artillery brigade, and it certainly had a rougher time; otherwise, as will be shown, the army field artillery was similarly situated to the heavy artillery as regards administration.

To turn to the heavy artillery organization, the circumstances here were different. When Field-Marshal Lord Haig succeeded to the command of the Armies in France the number of heavy batteries was not great, and the few that were in the country had only recently been organized into independent groups. No heavy artillery was permanently allotted to formations.

To obtain the necessary elasticity at the commencement of Lord Haig's tenure of command, single batteries were moved from place to place; as soon as it became feasible the brigade system was re-introduced and the artillery brigades were allotted to armies, and by them to corps in accordance with the tactical requirements. The corps commander fought and administered his heavy artillery and army field artillery brigades. He was enabled to use his discretion as to the temporary attachment of any of these units to divisions as the situation demanded.

Organization in war depends on the possibilities of command and administration. These possibilities are limited by the capacity of one man's brain, the facilities for communication and the degree of movement that is going on. The more mobile the fighting, the fewer will be the units that can be controlled by one commander, and the greater will be the difficulty of communicating orders.

In large wars, unless the machinery of the staffs of the higher formations is so devised that the artillery apportioned to these formations can be conveniently absorbed and effectively directed, history teaches us that grand artillery tactics fail.

The following quotation from Lord Haig's Dispatch, dated the 21st of March, 1919, shows how this axiom was fulfilled:

In order to gain the elasticity essential to the quick concentration of guns at the decisive point, to enable the best use to be made of them and to facilitate ammunition supply and fire control, Artillery Commanders acting under Army and Corps Commanders were introduced and Staffs provided for them. This enabled the large concentration of guns required for offensives to be quickly absorbed and efficiently directed.

Each corps commander was also provided with a brigadier-general and staff to command his heavy artillery. This officer was under the direct orders of the G.O.C. of the artillery of the corps. In fine, both army and corps commanders were given an instrument which they could employ as and when they liked to handle their artillery concentrations, and to be technically responsible for the efficiency of the arm.

It is an historical fact that the artillery commander always crops up in war where artillery is, comparatively speaking, plentiful and well handled. Queen Elizabeth had her artillery commanders (these fortunate gentlemen had certain perquisites in the way of church bells after successful sieges)*; Marlborough had his artillery train commander; Napoleon's first command of importance was that of the whole of the Jacobinic artillery in 1783, while in the following year he was appointed "General in command of the artillery of the Army of Italy," which Massena commanded. At Friedland, where artillery played so large a part, Senarmont commanded Napoleon's guns. Alexander Dickson was Wellington's gunner, but the part played by the artillery in the Peninsular War is singularly neglected by the historian Napier.
[* Extract from an Ordinance issued by Queen Elizabeth under her Sign-Manual: "Item - As a Town is won, whether it be by assault, per force, subtile practice, or any other manner given up, be it Town, Castle, Pile, Church, or Bastile, or Fortress, the Chief Master of the Artillery or his Lieutenant, shall ordain that the Master-Gunners and their companies shall have the best bell within that place so won, or the church wardens shall appoint or compound with the Great Master or the Artillery and his Counsel. And that to be reported by the Provost of the Artillery, and given knowledge to the Lords and Rulers of that place so won with the Commons of the same, what that the Master of the Artillery, His Counsel, and the Master-Gunners and their Companies have determined and ordeyned, by a convenable and reasonable estimation, to see and know if the Lords and Commons will hold the ordenance and appointment made."]

The poor results obtained by the artillery of both sides in the 1866 campaign may be traced to the want of efficient artillery control and direction. At the battle of Konigratz, half the mass of the First Army reserve artillery did not fire a single shot.

There are, however, a few soldiers who to this day think there should be no artillery commanders in war, and some of them may have formed their opinions from the teaching of the Great German General Staff. The Germans had no permanent artillery staffs for higher formations up to the day of the Armistice. Why was this? It was failure to draw the correct lessons from history, and the conservatism and vanity of their General Staff, who were lovers of centralization—usually the negation of efficient organization. These gentlemen were too vain to learn lessons from their enemies even in the pitiless school of war.

It has already been stated that there was no artillery staff machinery for higher formations in the German Army in the campaign of 1866, but before the war of 1870 began the Germans appointed corps artillery commanders. The results were not satisfactory from the point of view of organization and command, although the early entry of artillery into action (Worth) and the large concentrations of guns (St. Privat and Sedan) were successfully achieved. The system lacked elasticity. The position of the regimental colonel who became the commanding officer of the corps field artillery on mobilization left much to be desired. He commanded the corps artillery, and not the artillery of the corps. The German regulations laid down that when more than half the batteries in the corps came into action the commander of the corps artillery assumed command of the whole of the field artillery in the corps. The guiding principles of higher artillery control were neglected, especially the need of decentralization in moving warfare.

After the Franco-German War the Germans, instead of moulding their organization and artillery command so as to get the best value out of their guns, deliberately destroyed the poor machinery then in existence.

As far as our own original little Expeditionary Force was concerned, it only possessed six 60-pounder batteries, in addition to the divisional artilleries, and the question of higher artillery command did not arise. When the artillery staff organization was set up the success of this wise measure of decentralization was made certain by the close and willing co-operation of the whole British Service.

III. Scientific Progress.

It is common knowledge that, after the fighting of the autumn of 1914, the Germans were in possession of practically all the high ground on the northern part of the Allied battle front, and therefore of the observation. This very much increased the difficulties of the British gunner. The Flying Corps and the Survey Sections came to his help; without them he would have often shot "blind."

Before this war but little shooting practice took place at night, and the serious effect of a change in meteorological conditions on the range was not fully appreciated by the regimental officer of the Field Army. A careful study of the weather, however, enabled corrections to be made in the range. Tables were supplied to battery officers giving the necessary alterations. It may not be generally known that a gun of large calibre will sometimes vary by 1000 yards in twenty-four hours, owing to changes of weather.

Science was also called in to ensure the correct height of burst of the shrapnel shell. The barometer and thermometer became indispensable artillery stores. For night firing electric lights were supplied for the aiming posts to make certain of the gun being on the correct line, and electric torches were supplied for gun pits.

Accuracy of fire was still further ensured to the field artillery by the establishment of calibration sections. By firing through screens the exact initial velocity of each gun was ascertained, and compensation could be given on the sights which insured the uniform shooting of every gun in the battery.

The Survey Sections supplied the artillery with excellent maps which were compiled with care and accuracy, and mounted on specially prepared boards in order to facilitate "map shooting"; further, the Survey Sections resected all batteries' positions.

The culminating result of this scientific progress was that in the Cambrai attack of November, 1917, registration was dispensed with, and surprise, so far as artillery action was concerned, was made easy. At the battle of Amiens on the 8th of August, 1918, in which over 2000 British guns were employed, practically all of them opened destructive fire from their attack positions for the first time on the actual morning of the assault.

Though observation was carried out from the ground whenever practicable, the Air Force became to a great extent the real "eyes" of the artillery, and not merely the eyes, but also the scouts, the detectives and the tale bearers of bad shooting. By means of the aerial photograph camouflaged German batteries, new works, roads and paths were discovered, and accuracy of fire assured. It was useless for a battery commander to say that his guns were calibrated and clean and the ammunition properly cared for, when the tell-tale photograph showed a bad "pattern."

Not only was observation from the air accurate when stationary objects were engaged, but special progress was made in the art of engaging moving targets.

Counter-battery work, so little thought of before the war, and which, according to Ludendorff, caused the Germans much loss and great anxiety, became an exact science through the development of air photography, aerial observation, sound-ranging, flash-spotting and air-burst ranging. In every gunner office in our Armies in France sat a reconnaissance officer, whose duty it was to keep track of each German gun and to bring to notice the slightest alteration in the terrain on his immediate front, which was constantly photographed.

As to improvements in artillery design, long-range modern 6", 8", 9.2" and 12" howitzers were introduced and also the following guns:- 6" Mark XIX. on a field carriage, the 9.2" Mark XIII., the 12" and 14" on railway mountings.

G.H.Q. wished the split trail system to be gradually adopted for all light and medium natures of artillery, but this did not materialize for several reasons, two of them being that with a high rate of ammunition expenditure (it reached over twenty-three thousand tons on one day in the war), alteration in design was not easy, and that daily throughout the war the man-power problem became more difficult.

Among other improvements and innovations were the instantaneous fuze No. 106, smoke shell, gas shell, shells with large calibre head radius (long pointed shells), stream line shells, improved incendiary shells and star shells.

IV. Conclusion.

There are people who think that wars are things of the past; we all hope so. There are others who think that tanks and aeroplanes will compose the fighting forces of the future, and that any guns not used in these machines should be relegated to the museums. A design of a shellproof tank has not yet materialized, owing to the immense weight of the armour which would be required for its protection, and until this problem is solved tanks will be largely dependent on artillery protection. The analogy of a battle of tanks with a naval battle is a bad one, especially if aerial or submarine attack be left out of account. Ships have only to reckon with guns fired from other ships, unless the fighting takes place within range of shore guns; whereas, operating as they do on dry land, tanks must always be exposed to the fire of batteries, which are mobile and usually concealed.

Of the future no one can talk with certainty, but of recent history we know something, and it is worth noting that the officers and men of the Tank Corps were the first to admit, on the evening of the 8th of August, 1918, that it was due to the supremacy of the British artillery that their course had been an easy one that morning. Here is what the Field-Marshal says on the subject in his Dispatch, dated the 10th of April, 1919:

As an instance of the interdependence of artillery and tanks we may take the action fought east of Amiens on the 8th of August, 1918, and following days. A very large number of tanks were employed in these operations, and they carried out their tasks in the most brilliant manner. Yet a scrutiny of the artillery ammunition returns for this period discloses the fact that in no action of similar dimensions had the expenditure of ammunition been so great.

And what good would the artillery have been on the 8th of August, without stout infantry to hold the ground which tanks, aeroplanes, cavalry and guns had assisted them to win?

In the autumn of 1918, when the enemy was in full retreat, large masses of artillery were still employed; on the 1st of November, 1918, the fine Canadian infantry attacked south of Valenciennes, supported by guns and howitzers to the number of one to a little over every two yards of the front of attack, a large proportion of the barrage being in enfilade. This was a higher percentage of guns to infantry than had ever been reached throughout the war.

So much for recent history; what mechanical improvements the future will bring no one can foretell, but they will probably be greater than most of us think. Those who are still interested in the artillery service will, however, be well advised to go forward with experiment and research, and to lay their plans for a quick and larger output of the latest patterns in the event of trouble. The gun-howitzer seems to be the weapon of the future; that is to say, a weapon longer than a howitzer but shorter than a gun, with some of the advantages of both. In future wars an enormous increase in the number of aeroplanes employed in bombing and shooting the troops on the ground must be anticipated. All artillery weapons, or nearly all, should be able, therefore, to put up an air barrage, and construction must allow for a very high-angle of elevation. All such weapons also must be capable of quick and wide traverse in order that aeroplanes and tanks can be early engaged. Here the split trail comes in. A tank travelling at the rate of twenty miles an hour should not be a difficult target for the gunner, if he is supplied with an up-to-date weapon.

Space forbids me to mention the many other directions in which improvements can be sought.

Work and foresight will, however, be of no avail unless the fighting men again display that indomitable courage and power of endurance without which no war can be won. Let me take two examples from among the many of what happened before a mastery over the enemy's artillery and aircraft was obtained. Here is an extract from the official report of a certain artillery brigade during a period in the line in France. Probably no other brigade had a worse period, or even as bad a one:

The whole area was almost continuously under shell-fire, and the enemy's artillery fired hundreds of rounds daily onto the batteries, endeavouring to silence them. By night he made use of great quantities of gas-shell, using for the first time mustard gas. Although he was successful in knocking out during this period an average of three guns and one howitzer daily, and causing casualties to the number of 50 officers and 452 men, the tasks ordered were invariably carried out.

Another report on a battery reads as follows:-

The battery was assigned the task of wire cutting from __ to __, it had already received much attention from German heavy howitzers. It was estimated that 400 rounds would be required to clear the wire, and deliberate fire was commenced. After some 50 rounds had been fired a 15 cm. howitzer battery, firing in enfilade, opened a steady and very accurate fire on the position. Each time the British battery opened fire salvoes of 15 cm. commenced, and four guns out of six were put out of action and two ammunition dumps exploded. The remaining two guns continued to fire until 400 rounds were expended; subsequent examination after the advance showed that the wire was completely cut.

Needless to say, the gallantry displayed by all ranks of the artillery did not pass unnoticed. The gunner yields to none in his admiration of the bravery of other arms, but, as this article deals with the artillery, no excuse is needed for quoting the following extract from a Special Order of the Day, issued by Lord Haig on the 9th of October, 1917:

In preparing the way for the infantry, supporting their advance, and covering them against counter-attacks, the skill and endurance displayed by the Royal Artillery have never been surpassed, if ever equaled, in the annals of warfare. Though the nature of their duties has allowed them no rest, they have risen superior to every trial. Without their splendid devotion to duty the great successes gained would not have been possible

39: C. N. F. Broad, "Artillery Intelligence and Counter Battery Work," 1922

Lieut.-Col. C. N. F. Broad, D.S.O., R.F.A.
Source: *Journal of the Royal Artillery* 49:4

DURING the late war the Artillery intelligence service and the counter battery staff were two distinct organisations, although they dealt with one and the same subject—the defeat of the enemy's artillery.

In the early days they were so separated, that they were of little assistance to one another.

As the war progressed, they drew nearer and nearer, until they finally worked in very close co-operation, and practically became one service. The creation of the Artillery Survey companies has finally joined them together.

Counter battery work probably provides the best example in the Army of close co-operation between Operations and Intelligence. All fighting intelligence must be red hot, and hardly a shot is fired from the operations branch of the counter battery office, the reason of which cannot be seen at a glance in the intelligence branch. Furthermore, should the intelligence branch collapse, counter battery work practically ceases.

Counter battery work, tactically speaking, was very much neglected during the war, except by those immediately concerned with it. To the majority of officers it was practically a closed book.

When people do not understand an organisation, they can do little to help it, and counter battery work needs all the help it can get from every possible source.

The average infantry or field artillery officer in France knew little of the science of counter battery work. He knew nothing of what went on behind him when the heavy shell were passing over head. He heard them continually droning above him, but as that always went on, it called for little comment. He knew less of what the shell were aimed at, or why. During the war this was largely unavoidable, but in peace time it is necessary to reduce this apathy by education and propaganda for two reasons:

i. Moral.
ii. Mutual co-operation.

Knowledge and realization of our own strength always increases our moral. A demonstration of the system in a counter battery office was generally a complete revelation to a battalion commander. He was then able to tell his men about what was continually being done, night and day, to defeat the enemy's guns; and also to explain the difficulties of the work and the reasons why it cannot always be effective. Then failure to stop the enemy firing was not put down to callousness or inefficiency, and mutual esteem resulted.

From this stage a desire to give assistance will develop, since the value of it, and the possible results to be obtained from it will be realized, and mutual co-operation will be greatly improved. As I will show later, reliable information about the hostile shell on landing is of great value in dealing with the gun that fired it.

Counter battery work is a tactical operation which is actively con-tinuous day and night, whenever the opposing forces are in contact. The same offensive principles govern it as other operations.

It can be divided into two phases.

iii. The continuous offensive against the hostile artillery is designed to undermine the moral and efficiency of the enemy's gunners, and is, in effect, a never ending attack against the whole hostile artillery resources. This offensive may be aimed more particularly at either the enemy's moral or his material. This is a matter of policy which must be laid down by the Higher Command.

> In France it was the enemy's material which was the main objective of the continuous offensive. It is on record on the authority of General Ludendorff that in one month in 1918, the Allied counter battery work destroyed 13% of the German guns on the Western front.

iv. The other phase is the attack of the hostile artillery during battle with the same object as all other artillery work at this period, i.e. putting the infantry on to the objective with as little loss as possible.

Before the late war, artillery in covered positions was practically immune from hostile artillery fire.

Numerous instances can be quoted both from the Russo-Japanese War, and every phase of the late war, of the paralysing effect of modern gun fire on infantry, when the circumstances have been such that counter battery work was either non-existent or ineffective.

As the Artillery came to take a larger and larger share in the fighting, it became essential to counter its fire. Various means to this end were involved. They were as follows:

- Artillery Sections, Field Survey Battalion, now the Artillery Survey company.
- Royal Air Force.
- Counter battery office.
- Artillery intelligence organisation.
- Counter battery communications.

A thorough grasp of the capabilities and limitations of each service is essential before the study of counter battery tactics can be commenced. Artillery Survey companies contain three units:—

Sound ranging detachments.
Observation groups.
Compiling Offices.

The object of Sound Ranging is to locate a hostile battery by means of the sound wave which is made by the piece being discharged. It can also be used to range our own batteries by locating the burst of each projectile.

A sound ranging detachment consists of 3 officers and some 75 men providing three reliefs for both apparatus and linesmen. The apparatus consists of 6 microphones, or automatic detectors, connected to a timing apparatus.

The latter is set in motion by a human observer called a "forward observer" in an "advanced post," so that the sound waves reach him a few seconds before they arrive at the microphones.

The forward observer is usually some 1000 to 1500 yards in front the microphones, in some spot where the hostile artillery is heard to the best advantage.

The microphones, for technical reasons, should be placed behind the main field artillery line.

The position of each microphone has to be surveyed very exactly, as an accurate knowledge of the relative positions of the microphones to each other, combined with the times the sound takes to reach each microphone successively, is the essence of the whole apparatus.

The surveying of the microphone base and the laying of the necessary connecting lines are the two factors which may cause the installation of a sound ranging detachment to be a somewhat lengthy affair.

In a well mapped country, a base can be quickly laid out and, as a temporary measure, cable can be laid instead of erecting air lines. In manner a detachment can be placed in action in 24 hours, although, as a general rule, it is not worthwhile to order a sound ranging detachment into action unless a halt of 48 hours is expected.

The instrument itself is placed well back for the following reasons:

It is delicate and expensive, and therefore has to be out of the shelled area.
Good weather proof cover is required for both the instrument and the computers.
Personnel engaged in paper work in which meticulous accuracy is essential must work under decent conditions.

The sound waves produced by the discharge of the hostile artillery and the bursting of the shells are heard by the microphones and recorded by the instrument on a piece of photographic printing paper. From it can be worked out the position of the piece and the locality of the burst, thereby establishing a shelling connection.

Sound ranging also gives a good deal of information regarding the nature of the piece which generally leads to correct deductions as to its calibre. This information is usually very difficult to obtain from other sources.

In France these detachments were placed all along the front to meet two general considerations:

They were placed directly opposite, if possible, the main groups of hostile batteries, as the best results are obtained when the line of microphones is at right angles to the line of fire.

It was also necessary that they should overlap so that the batteries placed between the main groupings should not be missed.

From this the reader will see the necessity of centralised control, as the positions of the detachments depended on the enemy's artillery groupings and not any corps or other boundaries we chose to make. The front covered by a sound ranging detachment is usually about 8000 yards. It can only function at very small angles beyond this base on both sides.

Sound ranging suffers from several limitations.

An adverse wind will usually prevent all action.

Heavy shelling tends to confuse the record, and lengthens the time taken to work out the results. With the regular base now in use, the shelling must become very heavy before work becomes impossible.

The long lines are very vulnerable and once installed cannot be moved, so that it is necessary to look well ahead and possibly forecast events before putting in a detachment. The time taken to work out a record varies from 5 minutes to half an hour according to its difficulty. Once located the officer dealing with the records can often recognise a battery immediately the paper comes off the machine, so that very prompt and accurate neutralization is possible. For this purpose a battery or batteries are affiliated to sound ranging detachments in order to take advantage of opportunities of catching the detachment at their guns. All activity is at once reported to the C.B.S.O. together with any action taken.

As regards the Observation Groups.

The object of these is to locate hostile batteries by means of intersections by visual observations on their gun flashes.

The group consists of a headquarters and a varying number of observation posts working as a unit. Each post is manned night and day and is located in some commanding spot. High up and some way back is the best place to see flashes, and if convenient hills or church towers are not available structures are built in high trees. Each post has a spotting instrument with a graduated arc and is connected by telephone with its headquarters. The latter consist of the telephone exchange and a plotting board on which the positions and arcs of each observation post are accurately plotted. The chief difficulty in action is to ensure that all the posts working together as a unit are operating on the same flash. Special measures are taken to ensure this, so that very accurate trisections and even quadrusections are sometimes obtained.

Observation Groups are much quicker to install than sound ranging detachments, and can even function continuously in semi-mobile warfare. Under good conditions, they can set up and start work in 6 to 8 hours.

They can function to a great distance on a clear night, but are dependant on suitable ground for the best results. Their installation is subject to somewhat the same conditions and requirements as sound ranging, but the frontage is only limited by the necessity of getting intersections.

Neighbouring posts of adjoining groups can always be brought in for this purpose.

The headquarters can be well up with the posts if time is not available to lay long telephone lines.

Neutralization etc. is carried out in the same manner as with sound ranging. Both flash spotting and sound ranging can be used for ranging our guns, but it is not advisable to do this as a rule with sections that are used for intelligence purposes, as by doing so valuable information may be missed. Other posts, if available, can be installed for the purpose and good results obtained.

As regards the compiling Office :

During the late war this was located at Army Head Quarters. In future, it is probable that each Corps will have its own compiling office under the control of the C.B.S.O.

Its object is to examine all photographs of the counter battery area and accurately to plot the position of every actual or suspected emplacement in the area. It is really the authority for position. The Compiling Office and the Artillery Intelligence Office are in very close touch, so that it is hard to make an exact division of their titles.

Broadly speaking, the Compiling Office is responsible for technical accuracy from the Survey point of view while the Artillery Intelligence Office is concerned with the technical artillery point of view and for making deductions from the information supplied.

There is of course a lot of common land in between which they traverse together, the technical artillery and technical survey knowledge thus brought together enabling a true course to be steered.

The nature of their work makes the officers in the compiling office the photographic experts as regards battery positions. The results of the Observation Group and Sound Ranging detachments are tabulated and examined in the compiling office and activity charts are prepared either by this office or the artillery intelligence office as a general check on hostile artillery activity.

Under the 1918 organisation two very important documents were prepared in the army compiling office.

The hostile battery position list. (See App. I.)
The Counter battery map.

Both are kept up to date as much as possible and renewed whenever required, according to the changes in the hostile artillery.

The hostile battery position list shows every hostile battery position known on the Army front. It is not a list of hostile batteries but of places where they are or may be. Particulars are given about each battery position which may be useful to battery commanders for shooting purposes such as the exact map co-ordinates of each pit and those thought to be unoccupied.

This list is therefore for artillery use and is the bible of a battery detailed for counter battery work. All the batteries in its area are carefully marked up on the fighting map from the co-ordinates given in the list.

The counter battery map is usually printed on 1/20,000 scale and is a specially prepared map with detail not clear from the air fined down and other detail shown up. The map in fact is primarily for use from the air and is made to stand out clearly. All the battery positions which have been active lately are shown on this map in a clear manner—usually in black. The chief point to notice is that the batteries are marked on this map exactly as they appear to the eye. Thus a battery may be situated in a hedge running off a road—the four pits are shown in the positions in the hedge which they appear to occupy from the air, i.e. according to the photo, and marked with the zone number.

It is quite possible, however, that the hedge or even the road may be incorrectly marked in on the map, so that from the battery point of view the real position of one of the pits may be in the middle of the road, this being the real spot on the ground as given in the list. This would be unsuitable for the air observer as his map and the eye would not agree.

These two publications are entirely distinct and it is dangerous to mix up their issue; one goes to the R.A. and the other to the R.A.F.

This brings us to the part played by the R.A.F. in counter battery work.

Three units are used, viz :

The Corps Squadron R.A.F.
The Long range gun flight R.A.F.
The Balloon Wing R.A.F.

The Corps squadron does the greater part of the counter battery work. It has three flights, two of which are usually detailed for artillery work, while the third is employed on photographic work.

The remainder of the work, which is not so great in volume nor so continuous, being fitted in between the flights.

It is important to recognize the smallness of the corps squadron, as this greatly limits the amount of artillery work that it is able to do. If possible, the interior organization of the Heavy Artillery is made to fit in with the squadron organization, i.e. two artillery flights, so that the whole control can be decentralised by way of direct dealings between flight commanders and subordinate artillery commanders.

The squadron maintains an artillery patrol in the air during daylight. This means several machines in the day, especially in the summer. This patrol is of great value as it is a great source of information as regards activity, i.e. which positions are occupied. This information is sent down by means of the N.F. call which is taken in by all wireless masts and thus goes direct to the C.B.S.O.

It is also the duty of the patrol to examine the area and endeavour to locate new flashes or new positions together with any other artillery information which may be of value. The pilot uses his judgment as to the amount which he departs from his proper role, to engage hostile batteries or other targets seen. Information is required about all natures of targets as this patrol is an artillery patrol, not a counter battery patrol only.

The other main counter battery duty of the artillery flights is the observation of destructive shoots. In France these shoots were a most important counter battery task. The policy, as regards the hostile artillery, was a relentless attack which was practically continuous. The R.A.F.-observed shoot was the chief means by which this policy was carried out.

All that these observers are asked to do is to locate correctly the burst of each round and wireless it to the battery. Certain preliminary arrangements are essential to success. The observer must be given time to study the photo of the battery or batteries he is going to engage, and the pit most clearly distinguishable from the air should be selected for ranging upon. Furthermore the observer wants to know the position of the battery ground strips, by means of which the battery communicates with the plane, and also the calibre and mark of the battery together with the charge, so that the time of flight may be looked up. The observer requires this in order to be certain he is locating the right burst.

When actually observing, the plane flies in an elipse between the battery and the target.

The observer cannot keep his eye upon the target all the time, and moreover parts of the plane will obstruct the view during various portions of the elipse. Hence it is vitally important that the gun should be fired immediately the observer gives the order.

The breaking of the windows of motor cars passing in front of batteries during the war was, needless to say, due to the observer's order, and not to any desire on the part of the batteries to shake up the august ones inside! The return half of the elipse is utilised by the observer to wireless his observation on the last round.

The two artillery flights thus do all the observation from the air, and provide good information as regards activity. In actual practice in the war the pressure of work on these flights was so great, and always will be so, that the duty of intelligence is apt to take a rather bad second place. This deficiency is made up by the work of the photographic flight. This forms the basis of all counter battery intelligence.

The photograph is the eye of the counter battery artillery. From it may be obtained, in a complete manner, almost everything which is collected piecemeal from other sources, and moreover in not nearly so accurate a manner. On the photograph, position is absolutely accurate. It is almost impossible to hide a battery from the camera, however good the camouflage.

The camera will fail only when:

> The position is completely masked by foliage.
> The personnel never visit the battery.
> The dumped ammunition does not spread beyond the foliage or other complete cover.

The indications produced by blast marks, tracks, etc., forms first evidence of activity when the photograph is in the hands of an expert.

Photographs are of two kinds, operations and reconnaissance. The former are used for actual shooting and considerable detail is required. They are not usually taken at over 10,000', though cameras of greater focal length enable them to be taken at greater heights with approximately the same detail, but not always with the same definition. The latter are used for photographic reconnaissance of probable reinforcing areas or any artillery reconnaissance of that nature. They may be taken at 17000'. In this class of work a greater area with less detail is usually required. It is therefore necessary to state the approximate height required when photographs are ordered, always bearing in mind that photographic machines run considerable risk from enemy aircraft. The importance of the work must always be gauged against the probability of disaster when ordering low photographs any distance beyond our own lines.

The reconnaissance photos are perhaps used chiefly by the Artillery Intelligence at Army Headquarters who require to look ahead, and endeavour to forecast the enemy artillery operations. The Corps counter battery office is more occupied with the intelligence immediately connected with the actual fighting in progress.

The frequency with which photos are required in a stabilised battle varies according to the operations in progress. On a battle front new photos are required after any move on the enemy's part and in addition at normal intervals of about 3 days. This amounts to some hundreds of photos in a short time and entails an immense amount of work in connection with them, the organisation of which will be dealt with later. The speed with which a photograph can be taken, printed and distributed to the actual fighting unit is a matter of prime importance.

In order to expedite the delivery of the more important copies a primary and secondary issue is generally ordered. The primary copies can be distributed in a few hours, the secondary copies following the next day.

In France a normal primary issue of a counter battery photo was as follows:—

Squadron R.A.F.
C.B.S.O. (2 copies).
Corps Artillery Intelligence.
Army Artillery Intelligence.
Compiling Office.

Each squadron is provided with a "squadron artillery officer." In heavy fighting it may be necessary to have two officers as the duties are twofold.

Intelligence.
Operations.

The S.A.O. is the link between the C.B.S.O. and the observer. It is his duty to see that every atom of useful information is obtained after each flight. To this end he interviews all observers after landing, with the maps and photos, in order to check the information that has been sent in by wireless, and also to examine the observer with a view to finding out any further details regarding the hostile artillery generally.

He is in constant touch with the C.B.S.O. by telephone and attends all the C.B.S.O's conferences.

The A.O. has other duties to perform in connection with the actual shooting. He generally assists the squadron commander in allotting his resources to the work which has to be performed, as the demands are often in excess of what can be done.

He also visits the batteries and investigates failures, which are otherwise likely to cause lack of confidence on both the part of the B.C. and the observer.

When casualties are frequent and the observers young and inexperienced, he is also used to instruct them, so that they may have some knowledge of the causes that affect shooting and what the battery requires of them.

The Army Wing R.A.F. does no artillery work except photographs beyond the squadron line. These are either reconnaissance photos or special work for spotting the locations of long range artillery. This latter work can also be done by the special flights attached to the Corps Wing Headquarters. These flights would be used for this long range counter battery work when undertaken and in many respects it is better that they should take any photos required.

They are equipped in a special manner for their highly dangerous task. They have fighting machines of the first class as they have to observe many thousand of yards inside the enemy's lines. Sometimes, they are protected by special patrols provided by the Army Wing R.A.F., but it may not be possible to do this always. The machines are fitted with a wireless receiving set as well as a sending set, so that it is not necessary to return to the battery to read the ground strips. The battery has also to be specially equipped with a sending set. All sets have to be of a long range type suitable for the work. These flights only work with the long range guns, so that a very high degree of personnel liaison is possible between the guns and the observers.

There is an A.O. at Corps Wing Headquarters and his functions regarding these special flights are similar to those of a squadron artillery officer. He also deals with the artillery staff at Army Head-quarters and generally supervises the squadron artillery officers.

Balloons are organised in a Wing consisting of a headquarters in a varying number of balloon companies. Each Army in France had a wing and each corps a company. The company consisted of usually two and sometimes three sections, each section having one balloon with its personnel and transport.

The section was really the fighting unit. The company and wing headquarters being really administrative and training units; the wing being in close touch with the army and the company with the corps.

I mean by this that all operations work passed straight from the balloon to the fighting unit or military staff concerned and did not go through the company headquarters, although the latter was of course responsible for the technical efficiency of the balloons and their personnel in every way.

It is often thought that anyone can go up in a balloon and observe. This is by no means so. Balloon observers need a careful training in order to be as efficient as aeroplane or ground observers; in fact it is much more difficult to observe from a balloon than from an aeroplane. The specialities of map reading have also to be learnt and the art of using glasses in a balloon. The latter is a good deal easier nowadays than it was with the old unstable balloons. The work of balloons is almost entirely connected with artillery. It is incumbent on them to report general information when obtained in the same manner as other units. In Europe troop movements cannot be seen from balloons except in very large numbers, so that information of this kind is rarely obtained from them and does not justify the use of special balloons for this purpose.

In the East the situation is often entirely reversed. In Palestine, in times of good visibility, it was possible to see single Turks at 6000 yards; small bodies of troops and vehicles could be seen at much greater distances. In any case the moral effect of balloons is very great. They are credited with absurd powers of vision. I do not refer specially to this but rather to the way in which they advertise the advances made to the whole line. From any eminence the line of balloons can be seen for miles, and is a visible and tangible picture of the success of the victors and of the straights in which the vanquished have been placed.

Their real work and that for which they have been organised is counter battery intelligence and observation of artillery fire.

Shoots are arranged in much the same way as with aeroplanes. Balloons however have the advantage that the observer can talk to the officer commanding the guns all the time; the balloon is in fact only a glorified observation post.

All natures of guns can be ranged on targets in the forward area, but at longer ranges balloon observers find difficulty in ranging unless there is something definite to range upon, such as a hedge, so that the targets require carefully selecting.

The intelligence obtained from balloons is limited to N.F's, which, of course, can be seen with great ease. The observer is on a comparatively steady platform high enough to overlook all flash cover and very little should escape him. Difficulties however come in when he tries to make out the exact map square of the active hostile battery. His observations are bound to be inaccurate unless there is something definite to give him a guide, such as a wood or hedge. All the same, they are able to send in a lot of accurate information and furthermore produce a lot of confirmatory evidence as regards activity in certain localities which can be more accurately located by other means, such as photos.

This ability to locate active hostile groups of batteries is of particular value at night.

Balloons can send out N.F. calls if required like an aeroplane, in which case they are treated in the same way.

When communications stand, certain batteries are usually affiliated to balloons so that shooting can commence at once, and catch the hostile detachment at the guns.

This is particularly useful in the case of enemy balloon guns. The observer in the balloon sees the flash, and between that and the arrival of the shell he has plenty of time to ring up the battery concerned and get a shell back. If the enemy balloon guns are a nuisance they can be kept quiet by this method as casualties will be inflicted at the guns and balloon chasing ceases to be a pleasant afternoon sport! Balloons have great difficulty in doing accurate night work as they cannot say exactly where they are, so that any rays taken by them are somewhat unreliable. Good work has been done at times, but it cannot be depended upon.

Balloon communications are a somewhat complicated affair. They usually have a forward exchange in the battery area from which lines radiate to the people concerned. The personnel of balloon units are not very numerous so that, as in the case of observation groups, sound ranging, etc., they have to be helped out by the heavy artillery signal section—very often assisted by the Corps.

Balloons are quite mobile and do not advance through telephone lines regardless of other people's communications as commonly supposed! The balloon advances best inflated and can be warped over obstacles on the ground such as telegraph lines, without doing any harm or blocking the road. In fact fewer gas lorries are required by this method.

It does not take much imagination to see the use to which balloons can be put in open warfare provided they are in really close touch with the artillery, so many other sources of information having disappeared for the moment.

In order to get this close touch, balloon sections have been affiliated to heavy artillery brigades. The balloon is thus relieved of all communication responsibility except the line from the balloon bed to the heavy artillery brigade exchange, which in open warfare need not be long, as the balloon can approach much nearer.

The balloon then flies over its own artillery brigade and does observation and intelligence work in that brigade zone.

(To be continued)

40: "The Coming of the Creeping Barrage," 1931

By Major A. F. Becke, late R.F.A
Source: *Journal of the Royal Artillery* 58:1

IT has often been said that the creeping barrage was first used in 1916 by the XV Corps (Fourth Army) during the attack on the 15th September, sometimes called the Battle of Flers-Courcelette. Lately the writer has had to read through the mass of papers: war diaries, orders, instructions, reports, etc., which narrate and deal with the opening operations in the Somme Battle, between the 1st and 14th July, and in the files examined many documents have been found that throw further information on this step in the evolution of artillery fire-tactics. Before the references are lost it seems wise to place on record what has been discovered. Many officers who were concerned with this innovation have died, and with the passage of years it has already become difficult to say definitely when this change first came into use. Consequently for the assistance of the regimental historian of the future the writer has given here such information on the subject as he has been able to collect from his recent study of the con-temporary documents, supplemented by statements from various officers.

There is no doubt that the idea of affording protection to advancing infantry is very old. To mention only four cases from past history: in the first case, on the 25th August 1346, the day before the Battle of Crecy, Edward the IIIrd's archers loosed off a protective barrage of arrows to cover the successful crossing of the Somme ford at Blanchetache (near Saigneville). Another well-known case occurred at the Battle of Friedland, 14th June 1807, when Senarmont prepared the final advance of Dupont's Division of Victor's Corps by a sustained barrage from 30 guns, moving his guns forward twice when it became necessary to lift, and from his last position, when preparing the Russian infantry for Dupont's onslaught, the guns fired case shot at a range of 150 yards. The third instance occurred on the 31st August 1813, in the successful assault of San Sebastian, when, after a temporary failure, the stormers held on to the lower part of the breach, whilst the concentrated fire of 50 heavy British siege guns was turned on the high curtain. As one eye witness wrote at 7 a.m. on the 1st September: "So exact was the fire of our batteries that our shot passing over the heads of our men, then lying on the demi-bastion, carried away the heads of the enemy who fired from the ruins of the rampart of the curtain...." Consequently when a number of powder barrels and live shells suddenly blew up just behind the curtain, where they had been accumulated to assist the French in the defence, the British infantry, who had been lying out under the barrage, were able to deliver an immediate assault under cover of the smoke and general confusion and before any defensive measures could be taken, and the town was stormed. This exemplifies the very closest co-operation between assaulting British infantry and its covering artillery. The fourth instance occurred some years before the Great War, and it was an experiment that was carried out at the School of Musketry, Hythe, in which machine guns were used to give protection to advancing infantry by firing over their heads. Unfortunately, as it turned out, the targets representing the advancing lines were rather badly peppered, and not unnaturally this form of co-operation was not received with much enthusiasm by the infantry officers who were present.

To return to the coming of the Creeping Barrage in the Great War. At the outset it may be stated that the documents do not altogether support the oft-repeated story of the introduction of this barrage; but, as might be expected, they show that the innovation was of gradual growth and that it was being tried in more corps than one and at the same time. It is well known that normally a change would spring from the fighting troops, gradually, and generally it would be adopted, then in due course G.H.Q. would hear of it and in a circular memorandum give it an official blessing. Thus it happened in the case of the creeping barrage.

In this study it will be necessary to approach the subject historically, that is to glance through some of the earlier battles, so as to ascertain if the handling of the artillery in them can throw any light on the solution of this particular problem, and in doing so we can note, for the assistance of the regimental historian, some of the milestones in the progress of artillery tactics.

The artillery tactics of the pre-war training manuals were undoubtedly modified by the siege warfare conditions that soon prevailed, and possibly, so far as the creeping barrage was concerned, "as it takes two to make a liaison, both artillery and infantry are jointly responsible for its introduction." To begin with, it is an acknowledged fact that the "lifting barrage" had been foreseen before the war and had been alluded to in the *Field Artillery Training* of January 1912, and in the *Field Artillery Training* of April 1914 , for in both these manuals it is suggested [that] artillery is covering an attack and "it is no longer possible to continue firing at the immediate objective of the infantry the range of the artillery should be increased so as to search the rear of the position, but no considerable amount of ammunition should be devoted to this object," thus the 1914 issue; and in the 1912 book the instruction ran: "As a rule, therefore, the range of the artillery should be increased as soon as the infantry starts to assault, so as to search the rear of the position, but no considerable amount of ammunition should be devoted to this object." Here is a definite lift, but it is still a far cry from the procedure enshrined in these two manuals to the creeping barrage of 1917.

In the Battle of Neuve Chapelle, 10th March 1915, the first definite attack mounted by the British after the stabilization of siege warfare conditions, several milestones can be noticed. In this battle the artillery time-table was introduced, and the three phases given in the time-table were called: "the preliminary bombardment," "the assault of the enemy's first line of trenches," and "the assault of the Village of Neuve Chapelle." Also we do find the word 'barrage' used in the true sense of the word—a barrier, or dam, to prevent the arrival of reinforcements—and it appears in the First Army's Report on the operations: ...Artillery Bombardment. "... Other 18-pdr. batteries and 13-pdr. batteries were given the task of creating a barrage of shrapnel fire, so as to prevent reinforcements reaching that area of the enemy's position selected for attack...." Further before the Battle of Neuve Chapelle the R.F.C. photographed the German trenches that were opposite to the front of attack, and these trenches were then carefully plotted onto large scale maps, which proved of the greatest assistance both to the artillery and to the infantry during the progress of the attack, an innovation that was tremend-ously developed during the War, playing a particularly important part in mapping forward areas, enemy trench systems, battery positions, etc.

In the assault of the German position at Neuve Chapelle the guns covering the British made two main lifts, from trench line to trench line, and then beyond the final objective all 13-pdr. and 18-pdr. batteries were ordered to "establish a belt of fire round the front of the position," in other words to put down a curtain, or protective barrage. Thus Neuve Chapelle saw considerable evolution in the tactics of artillery.

In the Battle of Festubert, 15th-27th May 1915, corps artillery command was for the first time exercised in the field and this led to the appointment of a G.O.C., R.A., Corps, who in March 1916 was converted into a B.G., R.A. In this same battle the opposing trenches on the front selected for attack at dawn were between 80 and 200 yards apart, and, to cover the assault, the final phase of the artillery preparation was a H.E. bombardment by 18-pdrs. Under cover of this fire the assaulting infantry climbed out of their trenches and lay down in No Man's Land to wait for the moment of assault. Despite the dim light and the proximity of the opposing lines, no casualties from our own fire were reported, and in places the initial assault was successful. Possibly this epi-sode was recalled when the introduction of something akin to a creeping barrage was being considered. Before the opening of the Battle of Loos (25th September-13th October 1915) there was the first prolonged, systematic bombardment, lasting 4 days, but neither the number of guns nor the quantity of ammunition available were sufficient to make it really formidable. At Loos, too, Corps artillery organization came into being; and "the hour of zero" appears in First Army Operation Order, No. 95, and is possibly the first use of this term. But for the purpose of this study the most interesting feature of the battle was that just before the actual assault an 18-pdr. barrage was fired by the 15th Divisional Artillery, searching forward 50 yards at a time, the guns firing a certain number of rounds at each move. But though it was not an attack barrage closely followed by the infantry, yet it may have occurred to somebody that if only the assaulting infantry had kept close up behind this barrage as it swept slowly forward, then the attacking troops would probably have been saved from incurring such heavy losses. Generally, however, on the 25th September the assault itself was supported by lifting barrages, though doubt-less where the number of trench lines was considerable and close together something approaching the nature of a creeping barrage was fortuitously employed, as the field artillery fire progressed in rapid lifts from trench line to trench line firing a certain number of rounds at each move. The lack of success that attended the earlier attacks supported in this manner was sometimes due to the fact that at that time the infantry had not been sufficiently trained to get close up to the barrage, and on other occasions the barrage advanced at too fast a pace for the infantry to keep pace with it. Occasionally the last-named was due to the infantry misjudging the pace at which it would advance and asking for the lifts to take place too quickly, and then attempting to advance on the objective some time after the barrage had lifted off it, and the guns were serenely firing perhaps a thousand yards beyond the line where their fire was needed. In addition the Battle of Loos sounded the death-knell of the H.A.R. Group system, by emphasizing that a Corps Commander must control all the guns in his own area.

The next big battle, or series of battles, The Somme, which raged between the 1st July and the 18th November 1916, definitely saw the introduction of the creeping barrage, which was the most practical way of dealing with the enemy's plan of placing riflemen and putting machine guns in shell-holes outside his knocked-about trenches. Whether this innovation originally came from the French Army and was adopted by the British Fourth Army is still rather a matter of doubt, and some doubt also exists about the date of the introduction of the first creeping barrage in the German Army. To take the last-named case first. In 1916 the only attack made by the Germans on the Western Front was at Verdun (21st February-31st August), and in the orders for the original attack on Verdun, given in Part 1 of the official mono-graph, *Die Tragödie von*

Verdun (pp. 258, 259) there is no mention of any barrage, but only of a bombardment, and in the text the only word used is an "artillery curtain" (*Vorhang*), and this, presumably, protective barrage had already been employed by the British at Neuve Chapelle.

But the Germans do claim that just before the opening of the Battle of the Narotsch Lake (18th March-30th April) the "Fire roller" (*Feuerwalze*) was successfully used by the *86th Division* for the recapture of a hill near the Lake. It is also claimed that in a later stage of the fighting at Verdun a "rolling barrage" was used in May in the attack of Thiaumont by the *Jäger Brigade of the Alpine Corps.* On the other hand, in Colonel Bruchmuller's book, *Die Artillerie beim Angriff im Stellungskrieg,* several artillery orders are given as specimens, and on the Eastern Front, even as late as November 1916, these orders only speak of lifts of 100 metres. If an examination of the German documents in the possession of the *Reichsarchiv* shows that the creeping barrage was used by the German artillery at Narotsch in March, and later at Thiaumont in May 1916, then this innovation certainly occurred at an earlier date in the German Artillery than it did in ours. But as in the case of the leather guns of the XVIIth century, which were evolved about the same time and quite independently in Sweden and in England, so the creeping barrage, as far as the evidence available at present goes, probably was evolved independently on both sides of No Man's Land in 1916.

As for the French, no trace has so far been found in our documents of any proof that we are indebted to our Allies for this particular form of barrage, nor is it at all certain that a creeping barrage (*barrage mobile*) was being used by the French in the Somme battle. The French official volume dealing with this period has not yet been published, and there is no mention of such a barrage in the brief official report on their July operations that has been furnished to the Historical Section.

We now come to the examination of the procedure followed by the British artillery at the opening of the Battle of the Somme. It is unnecessary and it would be wearisome to examine and quote from the Diaries of all the 18 British divisions of the 6 Corps which took part in the attack on the 1st July, and it will suffice for our purpose to draw attention to examples of those changes in artillery co-operation which show traces, all along the front of attack, of close relationship to the procedure of the creeping barrage. At this time in France there were with the B.E.F. 3,304 field guns and howitzers and 714 heavy guns and howitzers, as well as 114 A.-A. guns; and on the 30,000 yards of the Somme battlefront from Maricourt in the south to beyond Gommecourt in the north the British employed 1,434 field guns and howitzers and 527 heavy guns and howitzers, a total of 1,961 pieces, giving an average of 1 field piece to every 20.9 yards, and 1 heavy piece to every 56.9 yards, or 1 piece to every 15.3 yards. This is a very different proportion to the artillery available at Loos, although the front of attack on the 1st July was fully twice as wide as it was on the 25th September 1915; and if on the 28th June zero had not been postponed for forty-eight hours, and the preliminary bombardment had not been extended for this reason for two extra days there would probably have been ample ammunition for every task.

To begin with, at a Fourth Army conference, held on the 16th April, in dealing with Artillery co-operation in the offensive which was then under consideration and with the experience of Loos fresh in his mind, the Army Commander stated: "... The lifts of the artillery time-tables must conform to the advance of the infantry. The infantry must be given plenty of time. The guns must 'arrose' each objective just before the infantry assault it. Timing is a matter of most careful consideration...." In a later conference held on the 17th May the Army Commander emphasized that on former occasions the lifts had always been too quick and not enough time had been allowed for the artillery to cover the advance of the infantry. But neither allusion to the artillery lifts lays stress on the barrage creeping forward by short lifts, and neither does much more than give vent to the pious hope that the barrage shall not run away from the infantry. In addition, in May 1916, the Fourth Army issued a brochure called Tactical Notes, and under the heading "Co-operation of Artillery with Infantry" (paras. 66-69) it was clearly laid down that the ideal was for the artillery to keep its fire immediately in front of the infantry as the latter advanced, but it also pointed out that this ideal was very difficult to attain. It was also made clear that experience had shown that the only safe method of artillery support during an advance was a fixed time-table of lifts to which both arms must conform; and the Notes stated that it was better for the infantry to have to wait in front of an objective until the artillery lifted off it, than it was for the artillery fire to be too far ahead of the infantry. It was laid down that if the lift happened to be a long one it should be carried out by stages, as it would thus be able to protect the infantry advance more effectively. This last sentence is most important for it emphasizes what is the germ of the whole idea.

The *Notes* are interesting for they show the trend of thought of artillery officers of light and learning whilst the great attack was being mounted, and even though they do not definitely prescribe the use of a creeping barrage, yet they show that the idea of short lifts, just keeping ahead of the infantry advance, had already engaged the serious attention of those responsible for issuing tact-ical instructions to the troops about to attack in the coming battle. But the Notes do make quite clear that in May 1916 the creeping barrage had not so far received official sanction nor had the name come into use. The closest artillery co-operation was essential, for the German position that faced the Fourth Army on the 1st July was far more formidable than any which the B.E.F. had previously assaulted. The Front Line, or system, was very strong, and behind it there were intermediate positions, numerous strong points and redoubts, and eleven strongly defended villages. Behind again was a well-sited, strongly wired and constructed Second Line or position.

Now we can probe lower down and see what procedure was actually ordered in some of the Corps and Divisions engaged on the British Front on the 1st July. In the XIII Corps, on the British right, the Corps Plan of Operations, issued on the l5th June, laid down in para. 11 (d) that "... the advance of the infantry will be covered by a heavy barrage from all natures of guns and mortars. The heavy artillery barrage will lift direct from one line onto the next. The field artillery barrage will creep back by short lifts. Both will work strictly according to time-table. The lifts have been timed so as to allow the infantry plenty of time for the advance from one objective to the next, on the principle that it is preferable that the infantry should wait for the barrage to lift than that the latter should lift prematurely and thus allow the enemy to man their parapets. The infantry will follow as close behind the barrage as safety admits...." In the foregoing extract, written before the attack on the 1st July, we notice the mention of the word "creep," and so far as the writer has been able to ascertain this, and its employment in the VIII Corps scheme issued on the 11th June, is the first time the word has been used to describe the procedure for advancing a barrage. In the two front-line divisions of this corps, the 30th on the right issued a barrage map, showing 6 lifts, but in the Divisional Operation Order No. 19 of the 21st June the word creep does not occur, nor is there any allusion to short lifts; on the other hand it was laid down that "... the Divisional artillery, firing only H.E., was to remain on each barrage line for one minute longer than the heavy artillery...."

In Operation Order No. 1, issued on the 19th June by the B.G., R.A., of the 18th Division, it was laid down in paragraph 14 that "... The bombardment to support the assault will consist of a concentrated bombardment from -65 to zero hour, followed by a succession of lifts timed to conform with Corps Artillery lifts and the forward movement of attacking infantry...." So as to cover the last thousand yards of the advance, after the formidable trench system on the forward slope in front of Montauban had been captured, the Artillery Orders laid down that "the Shrapnel barrage would move in front of the infantry by increments of range until the final barrage was established" to protect the infantry who would then be overlooking Caterpillar Valley. An amendment issued on the 27th June made it clear that during this thousand yards advance:—"Batteries ... will increase their range by increments of 50 yards every 1_ minutes." Reading the two together it will be seen that, in this part of the advance, a real creeping barrage was intended.

There is in a diary a description of what occurred on the 1st July: "... The general plan for the bombardment was an intense bombardment of the front line system for 65 minutes, followed by successive lifts from trench to trench. Then concentration of fire on certain trench systems and strong points, and finally a general barrage along the divisional front preceding the advance of the infantry by increments of range of 50 yards every 1_ minutes. The above plan was considered most adapted to the general configuration of the ground. The bombardment was carried out in accordance with the pre-arranged time-table, and the general timing of lifts appeared satisfactory ... as a whole the lifts appear to have suited the time of the infantry assault...." In passing it may be mentioned that the attack of the XIII Corps was by far the most successful of all those that were delivered by the British on the 1st July.

Now we can consider the artillery arrangements that made for the lifting of the barrage in the next Corps, the XV. In the instructions issued by the B.G., R.A. of the Corps on the 14th June it was laid down in paragraph 4: "...When lifting, 18-pdrs. should search back by increasing their range, but Howitzers and Heavy Guns must lift directly onto their next objectives..." Also accompanying the Corps documents there is an elaborate barrage map showing the proposed 6 lifts from the German front line back to Caterpillar Valley, and the west side of Mametz Wood. The barrage maps for the attack on the 1st July appear to be the earliest barrage maps issued in the B.E.F., as only bombardment maps were issued in 1915 before the British attacks at Neuve Chapelle, Aubers Ridge, Festubert, and Loos.

In the 7th Division of the XV Corps in Operation Order No. 11, issued by the B.G., R.A., at 7 p.m. on the 18th June 1916, there occurs the following paragraph which states very clearly the procedure that this divisional artillery was to follow in the attack on the 1st July. It ran as follows :—"... 3 ... (b) During the advance of the infantry a barrage of artillery fire will be formed in front of the infantry according to the timings shown on the tracings issued to those concerned. The lines shown on the tracings indicate the nearest points on which guns will fire up to the hour indicated. At the times shown heavy guns will lift their fire direct to the next *barrage* line. The divisional artillery will move their fire progressively at the rate of 50 yards a minute. Should the infantry arrive at any point before the time fixed for the barrage to lift, they will wait under the best cover available and be prepared to assault directly the lift takes place...." In this same division, the 7th, the Instructions for the forthcoming operations, "No. 3, Action of artillery and artillery co-operation" were issued on the 14th June, and in para. 1 (b) the divisional artillery was ordered to "move their fire progressively at the rate of 50 yards a minute," and the same procedure is given among the papers of the 22nd and 91st Infantry Brigades. Also in an appreciation of the task allotted to the 91st Infantry Brigade on the 1st July (attacking to the east of Mametz) there is a confirmatory reference "... the barrages of the Field Artillery move ahead of the infantry as it advances...," and in the Instructions for the forthcoming operations, No. 2, issued on the 19th June by the 20th Infantry Brigade, attacking on the left of the 91st, there is the paragraph "... *Method of Assault.* 10. The assault will be carried out steadily behind the artillery barrage. At the hour named for the barrage to lift the leading line will be as close to the hostile position as possible, and on the barrage lifting will at once move forward steadily, keeping touch, and only halt and lie down when next compelled to do so by awaiting the lift of the artillery barrage." As a result of his experiences on the 1st July, the Brigadier of the 20th Brigade was convinced that it was essential the objective should be entered immediately the barrage lifted off it. The attack of the 7th Division on the 1st July was very successful.

In the left division of the Corps, the 21st, "Instructions for Offence, No. 3," were issued on the 15th June by the B.G., R.A., and in para. 12 it was directed that "... Batteries will search back to the next barrage, in order that the whole ground may be covered by fire immediately before our infantry advance over it..." and the same order is found repeated in the papers of the 62nd Infantry Brigade. Further light is shed on the question by the documents of the 64th Infantry Brigade, the left Brigade, which attacked well to the north of Fricourt. In Operation Order No. 6 of the left battalion of this brigade, 10/K.O.Y.L.I., for the attack on the 1st July, it is stated in para. 6, "*Barrage* ... IT IS TO BE REMEMBERED, [sic] however, that this barrage will be lifted gradually, sweeping the entire ground before it, and the Troops must move forward as it advances so as to take all advantages of its protection...." Further, in *Omissions in Operation Order No. 25* which were issued on the 25th June by the left supporting battalion of the brigade, the 15/Durham Light Infantry, there is a very lucid and important explanation: "*Barrages.* The Barrages will not exactly lift from one point and be put onto another, they will gradually drift forwards, leaving certain lines at certain hours (which may be changed). The line of the barrage must be constantly watched by the infantry, whose front lines must keep close up to it...." The attack of this brigade too, was remarkably successful. Thus both in the artillery and the infantry of this division there was a clear conception of a field artillery barrage that would "drift forward" just in front of the advancing infantry, and in the extracts already quoted from the documents of the units of this Corps there is probably enough material to account for the belief that the creeping barrage did originate on the Somme and in the XV Corps.

But there is a different story to tell of the attack of the 50th Infantry Brigade, attached on the 1st July to the 21st Division. It was specially detailed for the capture of Fricourt Village so as to connect the two front line divisions of the XV Corps. Both in the Brigade Operation Order No. 76 of the 22nd June and in the battalion orders of the 7/Yorkshire Regiment (Green Howards), issued on the 25th June, it is stated that after a thirty-minutes preliminary bombardment the barrage would lift 500 yards back at zero, and fifteen minutes later the barrage would again lift 250 yards further back, and continue on this line until 1 hour and 45 minutes after zero. The attack delivered by the 50th Brigade on Fricourt Village was repulsed with heavy loss.

In the III Corps documents there is an elaborate map showing the eight major lifts of the artillery barrage that were to be put down on the III Corps front on the 1st July, but actually on this day the barrage on this Corps front seems to have been made to jump from one trench system to the next, and jumping in this way the barrage never touched the intermediate shell-holes which held riflemen and machine guns. Possibly the costly failures in front of La Boisselle and Ovillers may be partly traced to this procedure. But even so in the 34th Divisional Artillery O.O. (No. 10), issued on the 18th June 1916, it is clearly stated that "... 3 (g) ... Lifts are timed to commence at the same time as Heavy Artillery. But instead of lifting straight back onto the next line, Divisional Artillery will rake back gradually to the next line.... The speed at which this rake goes back is shown in Appendix V...." In Appendix V the rake is shown to be either one short lift of 50 yards (in one case), or 100 yards (in three cases), or 150 yards (in two cases), and then lifting direct to the next barrage line.

In the 34th Divisional O.O. (No. 16) issued on the 15th June, there is a further explanation :— "... *Artillery.* 3... The speed at which this [Field Artillery] rake goes back to the next line will be calculated so that the shrapnel barrage moves back faster than the infantry can advance...." If there was any doubt before whether this rake was a creeping barrage in embryonic form, this explanation shows that the real idea underlying the employment of a creeping barrage is absent from "the rake" as employed by the 34th Division on the 1st July.

In the X Corps, in the attack of the Leipzig Salient, an interesting expedient was tried by the brigadier (Br.-General J. B. Jardine) commanding the right brigade (97th) of the 32nd Division. Recalling his experience of the successful combination in the attack of the Japanese artillery and infantry, in the battles of 1904/5, General Jardine insisted that the front lines of the attacking infantry of his brigade should creep out into No Man's Land before zero and lie down within 30 or 40 yards of the barrage that was then on the German front line, so that they could rush the German trench directly the barrage lifted off it. Acting in this way General Jardine's right battalion succeeded in forcing its way into the Leipzig Salient. Unfortunately there seems to have been no idea of any further advance close behind the barrage, indeed the map in the R.A. June Diary, which shows 10 distinct lifts, makes it quite clear that the lifts were from trench to trench, and in no sense was it a creeping barrage. Consequently, with the original penetration that had been achieved at zero, the advance of the 97th Infantry Brigade came to a standstill. Later on the Brigadier heard that the advance of his infantry had been checked in the Leipzig Salient but that the barrage was carrying on and lifting according to plan, so General Jardine gave immediate orders that two batteries should be taken out of the barrage and switched onto the defence of those men who were still maintaining a precarious hold on their gains in the Salient. This timely artillery co-operation undoubtedly went far towards assisting the hard-pressed infantry to hold what they had gained at the first onrush.

The projected attack of the 3rd Objective on this front was to have been entrusted to the reserve brigade, the 14th, and, accompanying the July documents of the 19th Lancashire Fusiliers of this Brigade, there is a sketch with a table showing the distinct lifts which were to be made by the covering 18-pdr. batteries when on this front the 14th Brigade attacked the German Second Line. The sketch shows that the barrage was not creeping forward, but jumping from one trench line to the next. In the 36th Division, on the left of the 32nd, the true creeping barrage was not employed, but the lifts were from one trench to another, whilst some 18-pdrs. and 4.5" hows. "walked up" the communication trenches. South of the Ancre, the first onslaught of the 36th was extremely successful and a deep penetration was achieved, though the gains could not be maintained.

In the VIII Corps to the north of the Ancre, a Scheme for the Offensive (69 typed foolscap pages) was issued on the 11th June. In this detailed scheme, if anyone ever lived long enough to read it through, there was a subsection (No. 13) dealing with *Artillery Lifts* which laid down that "times marked [on a certain map issued with the Scheme] are for Divisional Artillery Lifts. Heavy Artillery will lift, in all cases, five minutes beforehand. At the commencement of each infantry attack, the Divisional Artillery will lift 100 yards, and continue lifting at the rate of 50 yards a minute to the objective, firing 3 rounds of gunfire at each step. The Heavy Artillery will lift straight onto the objective...." Later on in this subsection there was a subdivision which furnished *Further Notes on Artillery Lifts*, and relevant extracts from them read as follows:—"... The rate of advance of the infantry has been calculated at 50 yards per minute.... It is the intention of the Divisional Artillery to assist the infantry forward by lifting very slowly 50 yards each minute.... The Infantry therefore must make their pace conform to the rate of Artillery lifts. ... The success or otherwise of the assault largely depends on the Infantry thoroughly understanding this 'creeping' method of the Artillery.... The Infantry must be taught to realise that it is better to be occasionally checked rather than our artillery should lift off the objectives too soon, thereby allowing the enemy to get their heads up and open rifle and machine-gun fire on the assaulting lines...." It will be noticed that these instructions for the lifts of the barrage in the VIII Corps were very complete and up-to-date, and even the word "creeping" was actually employed. The employment of this phrase was intentional, for in some further instructions, with regard to the advance on the 1st July from the 2nd to the 3rd objectives, the 4th Divisional Artillery was ordered "to creep forward" towards the Puisieux-Grandcourt road from the wire running north and south between the Beaucourt-Serre Road and the Puisieux road; and the 31st Divisional Artillery was ordered "to creep up the village [of Serre] at 50 yards per minute...."

In the Divisions which attacked on the VIII Corps front the right division, the 29th, on whose front the Hawthorn Redoubt Mine was fired, arranged for the guns to make short lifts. In the instructions issued about the 20th June by the E.G., R.A., para. 6 reads: "When lifting off the front line at 0000 fire will be brought onto the support line, but in no case will the lift be less than 100 yards. Successive lifts will be made every two minutes.... 100 yards at each lift...." In the 4th Division, attacking to the north of Beaumont Hamel and on the left of the 29th, in the Divisional Artillery Orders issued on the 22nd June the para-graph dealing with Artillery Lifts stated: "... The rate of advance of the infantry has been calculated at 100 yards per 2 minutes. The Divisional Artillery will assist the infantry forward by lifting very slowly at the rate of 100 yards every 2 minutes...." This method of lifting is described as "lifting by steps." These orders also definitely connect the rate of progress of the barrage with the advance of the infantry, and they give still another name to the barrage.

In the 31st Division, attacking on the left of the Corps front, in the Divisional Instructions for the assault, issued on the 26th June, and repeated in the Divisional Artillery Instructions the batteries are ordered in one case "to creep forward by 100 yards every two minutes," so that all through this Corps the creeping arrangement was well recognized. Yet on the 1st July the attack of the VIII Corps was a tragic failure. Possibly this was partly accounted for by the fact that although zero was at 7.30 a.m. yet the Corps heavy artillery lifted at 7.20 a.m. off the German front line to the reserve trenches, and at 7.25 a.m. they were joined by the howitzers which had been firing on the support trenches, whilst the 15" and 12" hows. pounded Beaumont Hamel and Serre. If any further warning was needed by the Germans that the assault was coming the Hawthorn Redoubt Mine (40,000 lbs.), on the right of the Corps front and in front of Beaumont Hamel, was fired at 7.20 a.m. Thus the up-to-date artillery arrangements of the Corps Offensive Scheme were nullified.

To the northward again on the 1st July the VII Corps of the Third Army made a subsidiary attack which was intended to pinch out Gommecourt, the most westerly point of the German line on the Western Front. For this attack the artillery issued a very detailed barrage map, but so far as can be ascertained in the 56th Division the field artillery seem to have lifted from barrage line to the next whereas in the 46th Division it was laid down that the batteries on lifting off the first barrage line would search and sweep back to the second line, and in a few cases thereafter the same procedure would be followed. Actually the attack of the 56th Division, delivered with great dash, met with considerable success at first, although the assailants eventually found it impossible to maintain the ground that they had gained at the first onset. The attack of the 46th Division failed badly.

The foregoing examination of the orders makes clear that along the front of attack on the 1st July there were several definite indications of the use of some form of barrage that might be looked on as a direct forbear of the creeping barrage; and both in the XIII and XV Corps, the two corps in which the greatest success was achieved, there were very distinct attempts made to advance the barrage by short lifts, putting it down in front of the attacking infantry as the men pushed forward.

We must now briefly consider the next operations on the Somme. With the capture, or occupation, of Fricourt on the 2nd June the first phase, the so-called "Battle of Albert," came to an end. To the north of Ovillers the attack was temporarily closed down, whilst to the southward a slow advance by siege methods had to be adopted, so as to gain a suitable jumping-off place for the second phase: the assault on the German Second Line which ran in front of Maurepas, Longueval, and the Bazentins, and behind Pozieres. In addenda to Operation Order No. 65 (X.4/1488/15) of the 9th Division, issued on the 7th July for the attack on Trones Wood, there is one paragraph which shows that the XIII Corps had not abandoned the idea of artillery fire creeping forward:—"... 3. The Lifts of the XIII Corps Heavy Artillery Group are as under:—Until zero minus 5, gas shells will be fired into Trones Wood. At zero, heavy howitzers will be firing at a point in Trones Alley 200 yards east of Bernafay Wood and will creep eastwards along Trones Alley." The 9th Division held Bernafay Wood, and Trones Alley ran between the southern ends of Bernafay Wood and Trones Wood, a distance of about 500 yards. Two days later another indication is to be found of this innovation in the 7th Divisional Artillery O.O. No. 19A, issued on the 9th July for the attack on Mametz Wood which was to be delivered on the 10th; and in this order the paragraphs (6 and 7) which give the lifts were amended to read as follows:—"... *Barrages*...At 4.15 a.m. all guns will search back or inwards (i.e. away from advancing infantry) by short quick lifts of about 50 yards every minute...."

On this same day (the 9th) the 25th Divisional G.S. Diary records a change that was soon to become almost the normal procedure:— "... From this date onwards the Division worked as a whole, less Divisional Artillery which only once later came under the Division. It became evident thus early that the Divisional Artillery would cease to form an integral part of the Division." The 25th and 32nd Divisions at this time held part of the X Corps (Reserve Army) front from La Boisselle northwards to Authuille Wood, and whilst the front of the 25th Division was covered by the 12th Divisional Artillery that of the 32nd Division was covered by the 25th Divisional Artillery. There is little doubt that it soon became evident that the creeping barrage, or "rake," or whatever it might be called locally, was of little use unless it was of considerable density, hence as each division was taken out of the line it left its artillery in action. Also all through these operations any apparent lack of communication between the artillery and infantry was most probably due to the communications being incessantly cut.

On the 10th July, in the attack of Contalmaison by the 23rd Division (III Corps), the lifts were not carried out as arranged in the original programme. During the attack the artillery observers reported that the infantry were running into the artillery barrage, an enfilade one, and the B.G., R.A., promptly took the responsibility of advancing the time of the last lifts. Thus in this early creeping barrage the time of certain lifts were actually altered successfully whilst the attack was in progress.

So we come to the dawn attack on the German Second Line from Guillemont to the Bazentins. In the Fourth Army Operation Order (32/3/35G), issued on the 10th July (when the attack was planned to take place on the 13th) it is stated that "... the bombardment ... will be as intense as possible ... for a short period prior to zero, when it will lift as arranged by Corps...."

There is nothing in this order that suggests that at Zero the barrage will lift and creep forward closely followed by the assaulting infantry.

In this attack the front allotted to the XIII Corps, on the right of the Fourth Army, ran from Trones Wood to the eastern edge of Bazentin le Grand Wood. In the left division of this Corps, the 3rd, the artillery orders, issued on the 13th July, show no trace of the employment of a creeping barrage; at zero the 18 pdrs. lifted back onto the support line, the next lift was one of 200 yards, the next of 100 yards, and the last lift was one of 300 yards. But in the XV Corps, on the left of the XIII, an indication of the creeping barrage is found. In this attack on the 14th July the XV Corps front lay between the eastern edge of Bazentin le Grand Wood and the western edge of Bazentin le Petit Wood. The Corps Instructions, issued on the 12th July, for the final bombardment and barrages on Z Day, were accompanied by a Barrage Map which showed 5 lifts, "B" to "F" , timed to take place at 1 hour, 2 hours, 2.20 hours, 2.40 hours and 3.10 hours after zero, and extending back from the middle of the Bazentin Woods to the middle of Bazentin le Petit village, but the orders accompanying the map made clear that "... the guns will search back quickly to the next line by very short lifts..." and the entry in the Corps G.S. Diary for the 14th July records: "... The barrages worked well, 7th Division infantry, in particular, advancing close under the barrage, reached their objectives with but slight [missing text]. In the

7th Divisional Artillery O.O. (No. 20), issued on July, it is laid down: "... 4... 18-pdrs. will always search back by short quick lifts to the next line..." and in an amendment to this same order further detail is given: "... 2 ... At 0.9 all guns and howitzers will lift back to the 'Red Line' in short lifts, 50 yards a minute...." In this same division for its attack on High Wood on the 20th July the Artillery Orders (No. 23, issued on the 19th) prescribed: "... 5 ... The first lift will take place at 0 and the second at 10 minutes. The lifts will be made in short jumps of 50 yards at a time...."

Thus we see that the change sprang from the line in the normal way, and it was gradually adopted by the attacking divisions, so all that remained to be done was for G.H.Q. to give the innovation its official blessing, and this was duly given on the 16th July; in a circular memorandum (O.A. 256) issued by the Chief of the General Staff from Advanced G.H.Q. at Beauquesne. It ran as follows: —

"One of the outstanding artillery lessons of the recent fighting has been the great assistance afforded by a well-directed field-artillery barrage maintained close in front of the advancing infantry. It is beyond dispute that on several occasions where the field artillery has made a considerable 'lift', that is to say has outstripped the infantry advance, the enemy has been able to man his parapets with rifles and machine guns. It is therefore of first importance that in all cases infantry should be instructed to advance right under the field artillery barrage, which should not uncover the first objective until the infantry are close up to it (even within 50 or 60 yards). ... An infantry brigadier, whose command has met with conspicuous success, ascribes it largely to the fact that his men have insisted on advancing close under the field artillery fire ... and he has stated that on more than one occasion his men were thus enabled to gain an enemy's trench almost without loss, and in time to meet the defenders hand-to-hand as they emerged from their dug-outs and before they could mount their machine guns.
(sd.) L. E. Kiggell, Lieut.-Gen., Chief of the General Staff."

A month later in a Fourth Army Operation Order (No. 32/3/98G) for the attack on the 18th August against Guillemont and Delville and High Woods, there is this clear indication: — "... 3... At zero the infantry will leave their assembly trenches and advance to the assault covered by the Field Artillery Curtain, which will be regulated by Corps in accordance with the distance of the assembly trenches from the first objective. The infantry will follow as close behind the curtain as possible till they reach their objectives...." The innovation was receiving official approval in the highest quarters. Closely following on the above, further recognition of this innovation was given in a brochure, "Preliminary Notes on the Tactical Lessons of the Recent Opera-tions" (S.S. 119) that was issued in September 1916. This brochure emphasizes that, "... the infantry must conform absolutely to the time-table of the various lifts, and must advance as close to the Barrage as possible before it lifts.... [Under bombardment] the Germans ... are in the habit of ... taking up positions in shell holes in front and in rear [of their trenches]. A well directed field artillery barrage maintained close in front of the advancing infantry with very gradual lifts will enable such situations to be effectively dealt with...." Official blessing having been given to the creeping barrage, we should not expect to have to wait long for its universal introduction, for a name to be given to it, and for it to appear under that name in Artillery Orders; and in the XV Corps Artillery Operation Order (No. 47), issued on the 12th September in connection with the arrangements for the attack on Flers on the 15th (sometimes called the

Battle of Flers-Courcelette), there is this paragraph: "... 4. The 18-pdr. Barrage will be divided into two parts: (a) Stationary, (b) Creeping. Two or three batteries per Divisional Artillery will be employed in searching approaches and the more distant communication trenches, headquarters, and roads. Of the remainder, three-quarters will be employed in the Stationary Barrage, and the remaining quarter in the Creeping Barrage." In paragraph 6 (a) of the same order it was explained that "the creeping barrage, from 6 minutes after zero, was to search back by lifts of 50 yards every minute." Naturally one point, and an important one, that had to be settled was how slowly the barrage must move so as to search out the shell holes thoroughly and also for it not to run away from the heavily loaded infantry who were unable to move very rapidly across the shell-torn ground. An artillery officer walked over the ground after the attack on the 15th September, in which a creeping barrage was fired from Pozieres to Courcelette at the rate of 100 yards in 3 minutes, and he said: "There was no doubt that a barrage at this rate fired by shrapnel was effective. The machine gunners were killed in their shell holes, and the shell cases covered the ground in a regular pattern." After more than a year of experiment and gradual evolution the creeping barrage had come to stay, and from now onwards constant use developed its application.

NOTE.—It is hoped that any officers in possession of further information upon this subject will send it to the writer at the Historical Section, Audit House, Victoria Embankment, E.C.4, for the use of the Official Historian.

ARMY	**G.O.C.**	**M.-G., R.A.**
Fourth	Genl. Sir H. S. Rawlinson, Bart.	Maj.-Genl. C. E. D. Budworth
Reserve	Lt.-Genl. Sir H. de la P. Gough	Brig.-Genl. W. Strong
Formed on the 22nd May, 1916; on the 4th July the Reserve Army took over the line to the north of the Albert-Bapaume Road, from the Fourth Army.		
Third	Genl. Sir E. H. H. Allenby	Maj. Genl. A. E. A. Holland

Corps	**G.O.C.**	**B.-G., R.A.**
XIII	Lt.-Genl. Sir W. N. Congreve, VC	Brig.-Genl. H. St. C. Lecky
XV	Lt.-Genl. Sir H. S. Horne	Brig.-Genl. E. W. Alexander, VC
III	Lt.-Genl. Sir W. P. Pulteney	Brig.-Genl. H. C. C. Uniacke
X	Lt.-Genl. Sir T. L. N. Morland	Brig.-Genl. C. C. van Straubenzee
VIII	Lt.-Genl. Sir A. Hunter-Weston	Brig.-Genl. T. A. Tancred
VII	Lt.-Genl. Sir T. D'O. Snow	Brig.-Genl. C. M. Ross-Johnson

Corps	**Division**	**G.O.C.**	**B.-G., R.A.**
1st July			
XII	30	Maj.-Genl. J. S. M. Shea	Brig.-Genl. G. H. A. White
	18	Maj.-Genl. F. I. Maxse	Brig.-Genl. S. F. Metcalfe

XV	7	Maj.-Genl. H. E. Watts	Brig.-Genl. J. G. Rotton
	21	Maj.-Genl. D. G. M. Campbell	Brig.-Genl. R. A. C. Wellesley
III	34	Maj.-Genl. E. C. Ingouville-Williams	Brig.-Genl. A. D. Kirby
	8	Maj.-Genl. H. Hudson	Brig.-Genl. G. H. W. Nicholson
X	32	Maj.-Genl. W. H. Rycroft	Brig.-Genl. J. A. Tyler
	36	Maj.-Genl. O. S. W. Nugent	Brig.-Genl. H. J. Brock
VIII	29	Maj.-Genl. H. de B. de Lisle	Brig.-Genl. M. Peake
	4	Maj.-Genl. Hon. W. Lambton	Brig.-Genl. C. Prescott-Decie
	31	Maj.-Genl. Wanless O'Gowan	Brig.-Genl. E.P. Lambert
VII	56	Maj.-Genl. C. P. A. Hull	Brig.-Genl. R. J. C. Elkington
	46	Maj.-Genl. E. J. Montagu-Stuart-Wortley	Brig.-Genl. H. M. Campbell 2nd-14th July
XIII	3	Maj.-Genl. J. A. L. Haldane	Brig.-Genl. E. W. M. Powell
	9	Maj.-Genl. W. T. Furse	Brig.-Genl. H. H. Tudor
III	23	Maj.-Genl. J. M. Babington	Brig.-Genl. D. J. M. Fasson
X	25	Maj.-Genl. E. G. T. Bainbridge	Brig.-Genl. B. R. Kirwan

41: Memo from MGRA at GHQ for Haig's conference with Army Commanders, 9 June 1918

Source: Rawlins Papers, RAI, file 11

Artillery Support in Battle

The conditions of 1917 permitted us to concentrate a very large mass of artillery for offensive action and our infantry became accustomed to look for lavish artillery support in their operations.

Today circumstances have altered and it is no longer practicable to concentrate artillery resources on certain portions of our front and to leave the rest almost bare.

Infantry therefore must be trained to fight and to manoeuvre under cover of artillery fire on the principles laid down in F.S.R. Part I, rather than to rely on the invariable support of a dense barrage.

The forward movement of our own infantry or the arrest of the enemy's advance can only be assured by the effective and combined fire of artillery, machine-guns, rifles and trench mortars.

42: Draft memo from MGRA, GHQ to GS, GHQ, 23 August 1916

Source: Rawlins Papers, RAI, file 12a

1. On several occasions in the present battle Division Commanders have altered the artillery programme of attack of their own guns previously ordered by the Corps and approved by the Army.

2. The success of artillery attack depends on concentration of forces and violence of effort, and any interference with artillery programmes based on these two principles will generally lead to disaster.v

3. Any concentration of artillery to be successful must be placed under the orders of one man who must make it plain to all concerned when the component parts of the concentration shall revert to the command of subordinate formations.

It is to be clearly understood that the command of the whole of the artillery of a Division, of a Corps, or of an Army, may be assumed at any moment by the next higher formation for the purpose of combined action, whether offensive or defensive.

When command has thus been assumed, orders or instructions issued to the resulting artillery mass are not to be modified by subordinate commanders except when a change in the tactical situation has occurred after the orders or instructions have been issued and time does not admit of reference to higher authority.

Appendices: Archival Documents

The documents below are, in each case, edited transcriptions of the originals. Spelling, punctuation, and word usage have not been modernized. Pagination has not been maintained, and footnotes from the originals have been placed at the end of paragraphs to which they referred.

1. Record of work carried out by the Artillery Branch of the Headquarter Staff, South African War
2. Practice Camps, 1912, and the Lessons to be Learnt from Them
3. Lessons to be Learnt from the 1913 Practice Camps
4. GHQ Notes on Artillery in the Present War
5. Memorandum on the Possibility of Undertaking Offensive Operations
6. 1st Army Methods for the Attack, 13 April 1915
7. "Object and Conditions of Combined Offensive Action," June 1915
8. CDS 50, Tactical Notes, July 1915
9. CDS 93, Report on Experimental Firing with 18-pr. Shrapnel and H.E. at Calais, November 1915
10. Minutes of MGsRA Conference, 24 December 1915
11. SS98/4, Artillery Notes Number 4, Artillery in Offensive Operations, April 1916
12. SS109, Training of Divisions for Offensive Action, May 1916
13. Notes on Artillery, June 1916 (Compiled by the General Staff.)
14. Report on Visit to III Corps, c. June 1916
15. Artillery Notes Number 5, Wire Cutting, June 1916
16. Letters from Major General Birch, June-July 1916
17. Birch's report on the Somme Bombardment, 9 July 1916
18. Artillery Lessons Drawn From The Battle Of The Somme, c. December 1916
19. SS139/4, Artillery in Offensive Operations, March 1917
20. SS157, Report on the Overseas Artillery School, Salisbury Plain, May 1917
21. Internal GHQ memo on limited attacks, 26 June 1917
22. Attack Barrages As Modified By The Enemy's Latest Tactics, 25 August 1917
23. General Principles on which the Artillery Plan will be drawn, August-September 1917
24. SS592, Catechism for Heavy and Siege Artillery Subalterns, October 1917
25. Artillery Instructions for the battle of Cambrai, October-November 1917
26. Lessons from the 1917 Battle Fighting of the Fifth Army from an Artillery Point of View, December 1917
27. Remarks on "Notes on the work of a Counter Battery Office," c. late 1917 (XV Corps)
28. Principles to Govern Artillery Defensive Arrangements on the Third Army Front During Winter 1917-1918, 18 December 1917
29. Fifth Army winter artillery guidelines, 1917-18, 27 December 1917
30. Birch's Report on Artillery in Defense, 10 February 1918
31. SS139/3, Artillery Notes Number 3, "Counter-Battery Work," February 1918
32. SS139/7, Artillery Notes Number 7, "Artillery in Defensive Operations," February 1918
33. Extract from the report on the Organization etc. of the IX Corps Artillery during the Operations from 10th to 21st April, 1918; May 1918
34. Fourth Army Artillery in the Battle of Amiens, 26 August 1918
35. Fourth Army Artillery in the Attack on the Hindenburg Line, c. October 1918
36. "The Development of Mobile Artillery, 1914-1918," 1919
37. Anon., "Artillery and the General Staff," 1919
38. "Artillery Development in the Great War," October 1920
39. C. N. F. Broad, "Artillery Intelligence and Counter Battery Work," 1922
40. "The Coming of the Creeping Barrage," 1931
41. Memo from MGRA at GHQ for Haig's conference with Army Commanders, 9 June 1918
42. Draft memo from MGRA, GHQ to GS, GHQ, 23 August 1916